# A CONCEPTUAL FRAMEWORK OF INFORMATION INFRASTRUCTURE BUILDING:

## A CASE STUDY OF THE DEVELOPMENT OF A CONTENT SERVICE PLATFORM FOR MOBILE PHONES IN NORWAY

by

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ABSTRACT


As the result of a steady increase in reach, range and processing capabilities, information technologies no longer appear as independent, but rather as integrated, parts of large-scale networks. These networks offer a shared resource for information delivery and exchange to communities that appropriate them for their respective purposes. Knowledge and understanding of such information infrastructures' development process, in particular of how to engage in and proceed to build them over time, are in short supply. We therefore need to develop and strengthen our theoretical understanding of the process by which information infrastructures are built. The aims of this thesis are thus to: (i) develop a conceptual framework to understand the process of building information infrastructures as evolution and construction, and (ii) provide practical insights and guidance to those involved in the building of information infrastructures in the business sector of mobile content services.

In order to facilitate the understanding of the process of building information infrastructures, this thesis takes as its starting point the existing conceptualisation of information infrastructures by Ciborra, Hanseth and associates and, in particular, their concepts of *heterogeneity*, *control*, *standards* and *evolution*. Their conceptualisation pictures the developments of information infrastructure as an evolutionary process which is intrinsically linked to the interplay between human and technical components, while taking into account the distinctive properties of information infrastructures. This thesis argues at the same time that this existing conceptualisation portrays information infrastructures as autonomous and under-theorises the multiplicity, the agency of, and the interrelations between information infrastructure *builders* and their *institutional context* in building processes.

The empirical basis of this thesis develops an in-depth interpretive case study of the process of building an infrastructure (the Content Provider Access, or CPA) for mobile content services in Norway. This empirical research focuses on the activities of those engaged in the building process, their complex and highly political interrelations, their institutional contexts as well as the technical components and networks involved. From 2002 and until 2004, 39 interviews were conducted across 23 different involved

organisations, and the process by which the CPA emerged has been analysed. The building process has been described as multifaceted, political and highly dependent on the fluctuating initiatives and efforts of a range of information infrastructure builders.

The contributions that arise from this research are not specific to the business sector of mobile content services and Norway, but have broad implications for information systems (IS) research, and for information infrastructure theory more specifically. In particular, this thesis develops five interrelated contributions, four theoretical and one practical. The primary contribution of this thesis is to extend the existing conceptual framework of information infrastructures by developing a conceptual framework of information infrastructure building. The building process is discussed as being shaped not only by both information infrastructures' evolution and relative autonomy, but also by the construction activities of humans as information infrastructure builders and by the institutional context in which their activities occur. Second, the extended framework developed provides inputs to ongoing debates in IS research related to heterogeneity and complexity, to the role of standards and to the end-to-end argument. Third, the suggested framework is arguably useful for understanding qualitative differences between different types of information infrastructures. In particular, the different conceptual extensions developed help to raise a range of questions relevant across corporate, business sector and universal information infrastructures. Fourth, this framework also contributes to the understanding of scaling issues related to information infrastructures by emphasising the builders, the role of their agency as well as their institutional context. Finally, practical implications are drawn for suggesting actors involved in building information infrastructures for mobile content services to direct their attention to and strengthen their knowledge of the community of builders, the various roles played, their institutional context, the politics of standards and openness and the wider context and implications of building activities.

PREFACE

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This thesis consists of six papers as well as an introduction. The papers, as listed below, are included as appendixes:

- o Nielsen, Petter. 2004. Implementing Public Platforms for Mobile Phone Content Services: Standardization in an Era of Convergence. In Leino, T. Saarinen, T. and Klein, S. (eds). *Proceedings of the 12th European Conference on Information Systems (ECIS): the European IS Profession in the Global Networking Environment.* Turku, Finland. 14-16 June.

- o Nielsen, Petter and Leopoldo José Nhampossa. 2005. Internationalization of Information Infrastructures and Control: Cases from Mozambique and Norway. In Bada, A. and Okunoye, A. (eds). *Proceedings of the 8th International Working Conference of IFIP WG 9.4: Enhancing Human Resource Development through ICT.* Abuja, Nigeria. 25-28 May.

- o Jansen, Arild and Petter Nielsen. 2005. Theorizing Convergence: Co-Evolution of Information Infrastructures. *Scandinavian Journal of Information Systems. 17:1, pp. 67-100*[1].

- o Kristoffersen, Steinar, Petter Nielsen, Ole Hanseth and Jennifer Blechar. 2005. "Ordinary Innovation" in Nomadic and Ubiquitous Computing: the need for alternative theories in an emergent industry. In Sørensen, C. Yoo, Y. Lyytinen K. and J.I. DeGross (eds). *Proceedings of the IFIP 8.2 Working Conference: Designing Ubiquitous Information Environments: Socio-Technical Issues and Challenges.* Cleveland, Ohio. 1-3 August.

- o Nielsen, Petter and Margunn Aanestad. 2005. Infrastructuralisation as Design Strategy: a Case Study of a Content Service Platform for Mobile Phones in Norway. Submitted to the *Journal of Information Technology, special issue on Claudio Ciborra and the information Systems Field: Legacy and Development.*[2]

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[1] This is a revised version of the paper: Information Infrastructures and Convergence. In Laukkanen, S. and Sarpola, S. (eds). *Proceedings of the 26th Information Systems Research Seminar in Scandinavia (IRIS): Scandinavian Approach to IS Research?* Poorvo, Finland. 9-12 August. 2003.

[2] This is a slightly revised version of the paper: Infrastructuralization as Design Strategy: a Case Study of a Content Service Platform for Mobile Phones in Norway. In Hustad, E. Munkvold, B. Rolland, K and Skiftenes, L. (eds). *Proceedings of the 28th Information Systems Research Seminar in Scandinavia (IRIS): Reaching out.* Kristiansand, Norway. 6-9 August. 2005.

o  Nielsen, Petter and Ole Hanseth. 2005. Open Standards for Mobile Content Services: a Case Study of the Norwegian CPA Standard. Submitted to the *Information Systems Research Journal.*[3]

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[3] This is a major revised version of the paper: Enabling an Operator-Independent Transaction Model for Mobile Phone Content Service Provision through the Open CPA Platform. In King, J. L. and Lyytinen, K. (eds). *Proceedings of the Workshop on Standard Making: A Critical Research Frontier for Information Systems.* Seattle, WA. 12-14 December. 2003.

## 1.   INTRODUCTION: RESEARCH MOTIVATION

As a result of a steady increase in reach, range and processing capabilities, information technologies no longer appear as independent, but rather as integrated, parts of large-scale networks. These networks offer a shared resource for information delivery and exchange to communities which appropriate them for their respective purposes. Such *information infrastructures* are complex in several ways. As they are composed of a variety of different components, their openness and heterogeneity make them inherently uncontrollable; through their expansion, these various interconnected networks enter new interdependencies; while they are based on extending existing technical and social networks, they also need to develop and grow over a long period of time; and, they are developed as a distributed activity. Examples of such information infrastructures include the Internet, National Information Infrastructure (NII) initiatives and industrywide EDI networks, as well as corporate-wide implementations of enterprise systems.

While information technologies increasingly develop as ubiquitous, heterogeneous and pervasive networks, there is a shortage of knowledge and understanding of their development process (Lyytinen and Yoo 2002). There is therefore a need to develop and strengthen our theoretical understanding of the process by which information infrastructures are built, and in particular, to open the black box of information infrastructures with respect to both their malleability and the context and process of their use (Orlikowski and Iacono 2001).

The challenges and dilemmas related to the emergence of large-scale, networked and thus complex information technologies are discussed within a growing body of research that conceptualises them as *information infrastructures*, and seeks to analyse approaches to their use that are different from traditional methodologies of information system development. While information infrastructures have been conceptualised from various perspectives (for example Branscomb and Kahin 1996; Hanseth 2000; McGarty 1992; Star and Ruhleder 1996), I primarily draw upon the work related to Ciborra, Hanseth and associates (see in particular Ciborra et al. 2000; Hanseth and Lyytinen 2004; Hanseth and Monteiro 1997). As archetypes, McGarty (1992) has conceptualised information

infrastructures as consisting of technical elements, while Star and Ruhleder (1996) have, on the contrary, conceptualised them as social structures. The conceptualisation by Ciborra, Hanseth and associates distinguishes itself from these approaches by dominating the IS field and by taking, as well as extending, an *ensemble view* (Orlikowski and Iacono 2001) of information technology by taking into account information infrastructures' distinctive properties (socio-technical, networked, distributed, etc.). This conceptualisation also explicitly draws upon Actor-Network Theory (ANT) (e.g. Monteiro 2000) and pictures the developments of information infrastructure as an evolutionary process which is intrinsically linked to the interplay between human and technical components. Economic mechanisms of networks are used at the same time to describe how information infrastructures evolve and how they are strongly related to what already exists; the installed base of, for example, end-users and their patterns of use; design and implementation practices; standards; technical components and investments. And when the installed base has reached a certain threshold, an information infrastructure gains momentum and develops with its own autonomy as an *"… evolving shared, open, and heterogeneous installed base"* (Hanseth 2000, p. 60).

The conceptualisation of information infrastructures (II) can potentially yield several key insights. Basically, IIs are understood as networks in the sense that a broad range of humans and non-human components mutually influence their development in a variety of ways. A range of factors such as people, institutions, standards and technical components influences human actors and their acts. Thus the acts are not independent, but constitute and produce socio-technical *actor-networks* (Monteiro 2000; Walsham 1997). As a consequence IIs do not develop due to planned and controlled actions by some developers, but rather in a process imbued with surprises, blockages, diversions, side-effects and vicious circles, as well as inherent tensions between the need for universal standards and locally situated practices (Hanseth and Monteiro 1997). It has been suggested that dealing with these challenges requires modesty – to accept and live with the complexity (Aanestad et al. 2005). More particular, technical solutions have been suggested to interconnect incompatible networks such as, for example, the gateways linking the various protocols (e.g., SMTP and Microsoft Exchange) for e-mail (Hanseth 2001). At the same time, flexible designs are suggested to avoid premature decisions resulting in lock-ins and obsolescence. For example, the flexibility the Internet offers has provided opportunities for a wide range of innovations and extensions over a relatively

long period of time (Saltzer et al. 1984). Strategies of cultivation and "bootstrapping" have also been suggested to expand and grow technical networks with limited content and few users (Hanseth and Aanestad 2003). For example, the World Wide Web was "invented" by developing a minimal technical layer upon an existing network (the Internet) and by taking advantage of existing information and information needs to attract users at an early stage (Tuomi 2002).

Although the conceptualisation of II developed by Ciborra, Hanseth and associates provides a highly useful starting point for understanding the emerging complexity of IIs, it also has some important limitations. While the conceptualisation of II has in theory drawn upon a socio-technical perspective (for example Monteiro 2000), it has in practice arguably positioned itself too closely to technological determinism. In particular, it portrays technology as autonomous by leaving developers simply with the ability to cultivate. At the same time, the multiplicity of its developers and their interrelationships have not been problematised. As a consequence, privileging human agency over technical and social structures, the multiple agencies of the different developers, as well as the role of institutions and IIs in shaping agency and their relationships, have been under-theorised. As a related concern, while the conceptualisation has emerged from studies of corporate infrastructures, business sector wide as well as more universal infrastructures (in particular, the Internet), its applicability across these different domains is a question left unanswered. I argue that complex infrastructures within different domains will most likely develop differently from, and will involve development approaches different from, for example, cultivation, "bootstrapping" and gateways.

Taking the existing conceptualisation of II as the starting point, this thesis seeks to address some of these theoretical limitations. In particular, it seeks to enrich the conceptual framework by providing a more constructivist account to improve our understanding and support for developing IIs specifically within the business sector domain.

The *first research aim* of this thesis is to develop an interpretative understanding of how IIs develop by enriching and extending the existing conceptual II framework presented by Ciborra, Hanseth and associates. This is pursued by providing the analytical focus on the process of *II building* seen primarily from the perspective of the people engaged in building, i.e., the *II builders*. A variety of builders are involved in fabricating, shaping and

giving form to IIs by combining different materials and social components in a distributed, dispersed and fragmented fashion. According to these builders' plans, their actions and political interactions and institutional influences, as well as the way in which they draw upon existing IIs, the II's trajectory (Strauss 1993) is influenced and changed. For example, in the case of the Internet, different people are engaged in developing its core standards and technical components (routers, etc.); building the applications and services; developing and providing the content; developing the laws and regulations related to intellectual property rights; negotiating and implementing political agendas and providing Internet services to various market segments. Taking different roles based on different aims, values and interests, the Internet's shape and trajectory can be seen as the sum of these independent activities, and as the result of the political game between the involved actors. This process is both the *evolution* of technical components, institutions and social networks, as well as their *construction*.

The *second research aim* has a more practical focus. This is to provide insights and guidance on the distributed, dispersed and fragmented building processes of business sector IIs based on insights from mobile content services in Norway. More particular, this thesis seeks to provide key insights into how to promote the development of a thriving mobile content service market, into which components and factors are necessary and play important roles in the building of the underlying II, as well as on the tradeoffs between closed and open approaches to content service provisioning. Table 1 below outlines both research aims.

**Table 1: Research Aims**

o Develop a conceptual framework to understand the process of building information infrastructures as evolution and construction

o Provide practical insights and guidance to those involved in the building of information infrastructure in the business sector of mobile content services

## 1.1.  An overview of the theoretical perspective

This thesis is concerned with analysing the intricate challenges of building infrastructures by drawing upon a case of mobile content services within the business sector domain. I critically examine and develop on four core concepts around IIs outlined by Ciborra, Hanseth and associates: *heterogeneity, control, standards* and *evolution*. These concepts are chosen particularly for their significance related to understanding the analytical limitations

concerning builders, their agency and the institutional controls that influence the building process. While the concepts are intrinsically related, they are taken up separately for analytical purposes. In this section I introduce and describe these four concepts, with the aim of showing the gaps in the theory where this thesis seeks to contribute. The description is related to the following themes:

- o  IIs as heterogeneous networks;

- o  IIs as autonomous technologies;

- o  IIs as technical standards; and,

- o  IIs as evolving, installed bases.

### 1.1.1.    *IIs as heterogeneous networks*

While "traditional" information systems can be characterised as being closed and as having a specific purpose for a limited number of end-users, II serves a wide range of users, end-user communities and types of applications (Ciborra et al. 2000). Therefore an II is not developed within some strict boundaries of a project and organisation (time and space), but the borders of and between different IIs are vague and are not always possible to predetermine (Neumann and Star 1996). Discussing the infrastructure of a "virtual laboratory" for more than 1400 biologists, Star and Ruhleder (1996) illustrate this by arguing how an II involves a network of humans, computers and practices; its variations across different laboratories; as well as its integration with its end-users' local and situated contexts. As a consequence, the heterogeneity arising from the distributed and diverse nature of the components comprising the II becomes a primary challenge for II developers to manage.

Even if the challenges of heterogeneity brought about by the networked nature of IIs are explicated, the existing conceptualisation is based on *some* developer dealing with networks' challenges through strategies such as cultivation (for example Hanseth and Aanestad 2003). With IIs as inter-organisational networks, however, they also have multiple and diverse builders. They are dealing not with a fixed central network hub where building activities take place, but with building as a distributed activity. This "fluid" (Laet and Mol 2000; Mol and Law 1994) and the interconnected activities involved in building IIs have not been focal issues to date in the conceptualisation of IIs when discussing heterogeneity. Conceptualising heterogeneity as *the* challenge which the II is

supposed to address (by, for example, the use of standards) does not paint the full picture of the building process either. In particular, the builders come together to create economies of scale, to harvest the benefits of synergies and to release the potential for creating an II based on their mutual complementarities. Thus, heterogeneity is not only a challenge, but can also be the *very condition* for creating an II. A perspective on the process of II development composed of multiple builders, their strategies and activities, the institutionalised social structures influencing their building activities as well as the multiple roles of heterogeneity, provides the potential to paint a more complete picture than the existing conceptualisation of II.

With this perspective my aim is to open a new and different arena that emphasises the politics (Markus 1983) and how the perspectives of II builders may diverge. Linking various technical components and practices will release and create tensions related to the distribution of roles, responsibilities and benefits as well as institutionalised approaches to developing IIs. While the II's very shape will be influenced by heterogeneity, the II will at the same time require heterogeneous applications and usages, within certain limits, to secure its growth. Heterogeneity thus should be re-conceptualised to capture these multiple roles, in particular those related to II building activities.

### 1.1.2. *IIs as autonomous technologies*

The development of IIs can be described as following the *economics of standards* (Hanseth 2000). Information Infrastructures are understood to evolve according to certain economically explained network mechanisms such as increasing returns, positive feedback, network externalities, path dependency and lock-in (for example Hanseth and Monteiro 1998; Shapiro and Varian 1999). A successful II is described to evolve through *self-reinforcing mechanisms* (Arthur 1994), which create momentum (Hughes 1987) as well as introduce strong conservative forces that make changing the network more difficult over time. As a consequence, the development of IIs is not primarily the results of central developmental activities, but is rather out of control, drifting and with side-effects (for example Ciborra et al. 2000; Rolland 2003). Thus, the scope of human intervention and control in the process of II development is assumed to be limited. This thesis questions this assumption.

Network economics captures the mechanisms and the lack of control on the demand-side (i.e., user preferences, practices and investments in technical infrastructure). At the

same time, it does neither capture nor provide a deeper understanding of the developers' activities (on the supply-side; i.e., the ownership of technical components and the investments and preferences related to building). Opening up the supply-side bolsters the argument that even if parts of the II exercise strong inertia, certain actors are in control, even if only to a certain extent, and related only to certain parts of the II at varying points in time.

As an example, the Internet is *the* archetype of an II due to its pervasiveness, ubiquity and size. But despite its nature the Internet is not completely autonomous. In particular, the way in which the Internet's address space should be controlled has been the subject of a heated debate over the years. This debate's significance and delicateness were elucidated prior to and during the recently conducted "World Summit on the Information Society" (WSIS) in Tunisia. Historically tracing these developments, the Clinton administration in 1998 took an initiative to avoid *ad hoc* distribution of domain names, which culminated in the establishment of the Internet Corporation for Assigned Names and Numbers (ICANN) (Hannemyr 2005). The ICANN administers the technical details of domain resolutions, protocol addressing and root servers. The debate's core lies with the role of the US Commerce Department and its ultimate supervision of ICANN. While the US administration seeks to continue its control, the European Union (EU) and other countries have argued for a change to a multilateral approach to control under which no particular nation-state will supervise how to preserve the Internet's openness. The more explicit criticism of the current situation points to ICANN being in the hands of the US government with a risk of censorship and political suppression. It is argued that no national state alone should control the Internet, which plays such a key role in the global economy. There is at the same time a strong counter argument related to the EU's suggested alternative to put the UN, more particularly the International Telecommunication Union (ITU), in control of ICANN. This move may seem democratic, but would also imply that countries such as China would play a significant role in how the Internet develops. Whether such an arrangement would result in curbing opposing voices, thus challenging democracy and freedom of speech globally; or, on the contrary, would make countries such as China change into a more open society, is at the same time an open question.

The point here is that the Internet is not under anyone's complete control, but the above example illustrates how it is under partial control. It also shows how control is exercised and that by whom it is exercised is an important as well as a highly contentious matter. It develops as a negotiated process and its development has a highly political nature. Thus, the concept of control should be re-conceptualised to capture these "pockets of control", the tensions between control and autonomy and the strategic significance of controlling and not controlling IIs.

### 1.1.3.    IIs as technical standards

According to their existing conceptualisation, IIs are multi-layered collections of resources for communication and interchange of data, consisting of hardware, software and services along with the necessary support organisation and personnel to develop and maintain them (Hanseth and Monteiro 1997). Such a concept of IIs draws heavily on the physical infrastructure as a metaphor. A caution when using metaphors is that they may rule out the contradicting nature of a phenomenon as they illuminate some, while hiding away other, central properties (Georgiadou et al. 2005). In this sense, drawing upon a metaphor of infrastructure may be problematic as it is commonly related to *physical parts* of underlying structures such as roads, sewer systems and telecommunication networks, and does not emphasise the social aspects involved in its building such as practices, institutions and politics. If the aim of II conceptualisation is to move beyond the socio-technical cliché, the metaphor of infrastructure must be used cautiously. In particular, we should not put a stronger emphasis on the role of technical components, such as standards and the economic mechanisms of their development, than on the roles of social and informal networks and coordination, as well as the institutional context.

Standards are commonly depicted as IIs' technical backbone (for example Monteiro and Hanseth 1995). At the same time, standards are much more complex and diverse as argued by, for example, Sahay (2003), illustrating how Global Software Alliances depend not only on standards for technical and physical components, but also standardised software processes and management practices. Further, IIs require the standardisation of a range of other issues as well, better conceptualised as a "package" (Nielsen and Hanseth 2005). Only partially are "standardised packages" (Fujimura 1992; Fujimura 1996) technical specifications enabling interoperability, and other parts consisting of less formalised and more flexible standards are equally important to make things work. The

role of "standardised packages" also includes influencing the roles to be played by the various actors related to the II and their distribution, enabling loose technical as well as organisational coupling, and influencing the degree of flexibility, i.e., which changes and innovations are possible. Moving beyond infrastructure as technical standards invites a re-conceptualisation of standards to also capture its non-technical components, their relationship within "standardised packages" and their multiple roles.

### 1.1.4.    IIs as evolving installed bases

The existing II conceptualisation has been concerned with issues such as economics of networks, flexibility of standards and the irreversibility of an II as an evolving installed base (for example Hanseth 2000; Hanseth and Lyytinen 2004; Hanseth and Monteiro 1997). Thus IIs are conceptualised as developing according to what already exists and as a process by which they are attached to existing networks; thus IIs take on an evolutionary character. While this captures the development of user population and their practices, the concepts are less developed toward a process theory of II *building*. In particular, the landscape of roles and actors involved in building IIs (the supply-side) has not been a focal issue (Jansen and Nielsen 2005).

A supply-side perspective raises several important issues: who are engaged in and how does decision-making unfold in II building; which actions are possible and plausible, and how are disputes between builders negotiated, resolved, bypassed or deferred; and what is under control, by whom, and how? Basically, I adopt a perspective on the process of building IIs that emphasises the interdependence between human and non-human actors and how they mutually shape and reshape the II. Thus, the variety of the components involved in the building process is not restricted to the diversity of the different actors, but also extends to how the various actors appreciate and interpret the various components related to their practices, perspectives and interests. Drawing upon my arguments for reconsidering heterogeneity, control and standards, I argue the need for conceptualising the building processes as something more than just evolution. In particular, I argue for the importance of emphasising the agency (Giddens 1984) of II builders and their *construction* activities in building IIs. While building is about changing, human agency may at the same time contribute to the stability of power structures and the IIs' institutional context.

### 1.2. Proposed perspective in this thesis: building II as evolution and construction

I argue for extending the *evolutionary perspective* on II development to also take into account interests, values and institutions and thus opposition, conflicts and contradictory forces at play in II building. The different II builders bring with them, and attach to the II they are building, their existing socio-technical networks. They do so to nurture their own assets as well as to retain their control over networks by drawing upon existing power structures. Builders at the same time bring not only their technical components but also their practice of building II. Institutions (DiMaggio and Powell 1991b; North 1990) such as practices, organisations, authorities, laws and regulations influence not only the individual builders, but also the structures (and the formation of these structures) between the different II builders. In this process, not only the materials put together but also those people who put them together are diverse. They thus must also be "engineered": "… persuaded to suspend their doubts, induced to provide resources, trained and motivated to play their parts in a production process unprecedented in its demands" (MacKenzie 1987, p. 28). I argue that this move is particularly appropriate as it brings on a less technologically deterministic perspective by especially emphasising the role of the social aspects in II building. I therefore treat IIs as socio-technical ensembles, rejecting that developments are autonomous and mainly out of their builders' hands, while trying to take into account technology's obdurate nature (Bijker 1995).

The existing conceptualisation of II explicitly draws upon ANT and grants both non-human and human actors the possibility of influencing its development (for example Monteiro 2000). The ANT (Callon 1986; Latour 1987; Law 1987a) approach describes technical components as actors, and attaches the same explanatory power to non-humans and humans. Together they form heterogeneous *actor-networks*, which are developed by actors moving and, at the core of ANT, translating other actors in the network. The ANT pulls apart ontologically and epistemologically from other approaches within the Science and Technology studies field (STS), such as Systems and Social Construction of Technology (SCOT) (Bijker 1995), by studying humans and non-humans with the same language and with a focus on how non-human and human actors influence other actors as parts of a collective (Latour 1999). At the same time IIs are described as developing according to certain economically explained network mechanisms such as path-dependency, lock-ins and momentum (Hanseth 2000). Hanseth argues that even if this

momentum is understood not to be given but to develop over time, the scope of human intervention is largely defined by the II. I argue that such a view understates the scope of human intervention, while ignoring other possible and more significant limitations of human agency related to the intricacy of building activities.

A focus on building as a process involving the evolution of technical arrangements, as well as the builders and their political and institutional context, makes us focus on tensions at several levels. At the same time, IIs are not just related to tensions, but tensions are a core constituent; *between control and autonomy*, *between heterogeneity and structure*, between *standardisation and flexibility* and *between evolution and construction*. Although IIs do evolve, they do not do so indifferently and indisputably as heterogeneous, standardised and autonomous processes. To capture this I conceptualise II *building* as an intertwined and dialectic process of *evolution* and *construction* leading to:

- o *Building* in the sense that IIs are the fabric of human actors, shaping and giving form by combining different materials and components;

- o *Evolution* in the sense that existing technical components, practices, institutions, etc. play a fundamental role in shaping the building process and the IIs' trajectory; and,

- o *Construction* in the sense that certain human actors at certain points in time have the control to plan and implement changes. At the same time, outputs are likely to be controversial, disputed and influenced by other builders, politics, power structures, institutions and existing IIs.

### 1.3.    Building a platform for mobile content services: the empirical basis

This thesis builds a conceptual framework based on an empirical case study of an II in the making. This object of study was developed also with the purpose of becoming an infrastructure: underlying, open to innovation, largely out of central control and composed of a range of heterogeneous components. Its builders were sensitive upfront to the mechanisms within which they were working and found it appropriate, as well as had the power, to engage in building an II from previous information systems. More particularly, the case study followed the process of building an II for content services for mobile phones in Norway: the Content Provider Access platform (CPA). There has been some interest in similar inter-organisational infrastructures, as is evident from the studies of structured information exchange, such as electronic data interchange (EDI), in different sectors and industries (for example Damsgaard and Lyytinen 2001; Forster and

King 1995; Nikas 2003), telemedicine (Aanestad and Hanseth 2000) and geographical information systems (Georgiadou et al. 2005).

To meet the research aims, the Content Provider Access platform's building was studied related to: how the infrastructure's building unfolded, which strategies were employed by whom, which actors were involved, what roles were played by human and non-human actors and what challenges were met or not met. The empirical research was based on and belongs methodologically to the interpretative IS research tradition (Myers and Avison 2002b; Walsham 1993). Developed as a case study (Yin 2003) continuing from 2002 until late 2004, a total of 39 formal interviews were conducted in a total of 23 different organisations including official government agencies and forums, the two Norwegian mobile phone network operators[4], a variety of content providers, as well as other influential actors. In addition to the interviews, data were also collected from studying standard documents and specifications, websites and the trade press.

The CPA's complexity is pronounced relative to previous platforms for content services in Norway offered by the network operators. In particular, a range of new actors is added to the value chain as a result of a variety of changes in the infrastructure. But the way the CPA was chosen as an approach for network operators in Norway, the process by which it was developed, and how it is operated today, are not only the concern and responsibility of network operators. In particular, CPA as an inter-organisational network is not based simply on the infrastructure of network operators, but also on the existence and initiative of a variety of other organisations. While the tasks of content production (to some extent), service innovation, branding, marketing, pricing, billing and transportation previously rested with the network operators, they are with the CPA only providing for billing and transportation services. The other tasks are distributed among new roles such as content producers, content providers, content aggregators[5], application houses[6], integrators and media windows[7]. All these actors are engaged in building the II, but they have neither the same history, size, interests, incentives, technical components and approaches, etc., nor a common understanding of how the II's building should proceed. At the same time, the CPA by principle is required to be discussed, negotiated

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[4] There are currently two mobile phone network operators in Norway: Telenor and NetCom.
[5] Aggregators are large content providers acting as mediators for smaller content providers.
[6] Application houses develop new software, services and service concepts based on the existing infrastructure.
[7] Media windows provide space for marketing, for example newspapers, magazines, TV-broadcasters.

and accepted as a common II throughout the market, thus drawing upon a complex network of actors.

## 1.4.    Expected contributions

The contributions of this thesis are related both to theory and practice. Theoretically, this thesis aims to contribute to II theory in particular, and IS research in general, with:

- o A conceptual framework of the process of II building, in particular related to the concepts of heterogeneity, control, standards and evolution;

- o new perspectives related to ongoing debates in the IS field concerning heterogeneity and complexity, the role of standards and the end-to-end argument;

- o a broader perspective on II diversity and specificity; and,

- o a better understanding of II scaling issues.

Based on an in-depth case study that elucidates the various actors and processes involved in the processes of II building, this thesis also aims to contribute practically. More particularly, a range of challenges that II builders confronted in the case of CPA are illustrated and discussed in relation to how to involve in building IIs for mobile content services.

## 1.5.    Organisation of the thesis

The rest of this thesis is organised as follows. Chapter 2 describes the methods applied in gathering data and their interpretation, together with an overview of the case. The empirical data and theoretical discussions related to IIs are presented in six papers attached as appendixes 1-6. In chapter 3 I provide a brief overview of these papers' research findings. Chapter 4 outlines the existing II conceptualisation and proposes an extended framework of II building. The framework draws primarily from the findings and contributions in Chapter 3, but conceptually also moves beyond them. Chapter 4's extended conceptual framework is discussed and its applicability is illustrated with the case of CPA in Chapter 5. Contributions and implications are presented in Chapter 6 and finally, some concluding remarks and future research directions are pointed out in Chapter 7.

## 2.   RESEARCH METHODS AND CASE OVERVIEW

This chapter opens by describing the research methods applied, and how the study of the CPA was designed. It continues with an overview of the CPA platform, as well as of how it relates to other types of mobile phone services in Norway.

### 2.1.   *Research methods and data interpretation*

The empirical research presented here started in 2002 and continued until late 2004. As my Ph.D. commenced I became involved in a large project studying various attempts to internationalise technical platforms across several Norwegian companies. One of these attempts concerned the CPA, a case that seemed to be of particular interest both for gaining practical insights and for exploring more theoretically the existing II conceptualisation. Especially, the CPA appeared technically rather simple, but at the same time seemed to be strongly influenced by, and to depend upon, other technical components and networks, varying practices of developing and implementing information systems, the participation and entrepreneurship of actors external to the network operators and the politics of their interrelationships, as well as upon laws and regulations. At the same time, previous to my Ph.D. I worked in a small software company that was involved with the CPA as a content provider. Thus I already had experiences with how the CPA operated technically as well as with the other processes and issues involved in content provision such as, for example, the role and importance of coordination and negotiation with aggregators and network operators.

Early discussions with people developing the CPA platform and who were involved with its internationalisation attempts directed my attention to further investigating the CPA's complexity and the challenges related to its standardisation, implementation and operation. To better understand these issues I initiated an in-depth study of the CPA in Norway. My relation to Telenor and Telenor Research and Development also influenced this choice, in particular related to concerns about access. Starting by interviewing one of the network operators' CPA manager brought my attention to how closely the CPA was interrelated with other (internal) technical platforms and with other (external) actors within the business sector. I also found that the relationship between the various actors

and the processes of coordination among them appeared to be intricate, which led me also to study the CPA's origins. Thus, the case study reached both back in time toward the CPA's predecessors, out into the business sector, as well as out into the more "global" setting related to the internationalisation attempts.

### 2.1.1.    Research strategy and design

Essential for a research design is the choice of an exploratory or explanatory approach (Yin 2003). Whereas an unexplored research problem and limited knowledge of it suggest the need for an exploratory approach, a well developed research area with clearer research problems may suggest an explanatory approach. The focus of these approaches differs in the way that the exploratory approach will centre on building new concepts while the explanatory will seek to test theories. Where explanatory studies may pursue causal explanations, exploratory approaches will be more descriptive. The choice between these approaches relates to philosophical assumptions: positivist, interpretive and critical perspectives (Myers and Avison 2002a). In particular, these different perspectives bear with them different assumptions about what is "valid" research and thus, which methods are appropriate. Basically, positivist research assumes the existence of an external world independent of the researcher that can thus be measured with "objective methods" (for an example of a positivist approach, see Bensabat et al. 1987). On the contrary, interpretive research argues that the world is not external to us, but is always accessed through our social constructions (for an example, see Walsham 1993). Critical research assumes that conflict to be endemic to all social systems and aims at bringing to light the oppositions and conflicts with the aim of supporting emancipation through critique (for an example, see Ngwenyama 1991).

With the aim of developing a deeper understanding of the research area, and because the CPA appeared inseparable from its context, this research followed an interpretative kind (Walsham 1993; 1995) of exploratory case study approach (Yin 2003). The primary aim was not to tease out some "objective" truth about mobile content services and the CPA, but rather, through interpreting the different perspectives of the different people involved in building the CPA, to provide a deeper understanding of the process of its building. By focusing on the interrelationships between the II and the context in which it emerged, a range of influential factors shaping the various builders' understanding of the building process, and thus the building process itself, have been identified, analysed and discussed. While the interpretation of the building process has differed substantially

between the involved builders, I have tried to express and develop a more shared understanding.

My stance is thus based on the reality as socially constructed and reproduced through ongoing interactions (Orlikowski and Baroudi 1991). This implies that the social reality only can be interpreted, and thus our knowledge about reality is socially constructed (Walsham 1995). While acknowledging that my position as a researcher has not been value neutral, I have attempted to understand the various perspectives of the people involved in building the CPA. Where I have described these various perspectives, the involved technical components' properties and how they have come into being, as well as the relationships between the various actors, it reflects my own interpretations. Thus, my role has been to report my interpretation of other peoples' interpretation of building the CPA.

The more practical parts of my research strategy were based on an understanding of II building processes as being open and interrelated with their context. The research approach centred on tracing the involved technical components, human actors and their social networks and interests in building the CPA platform. I focused primarily on the aims, values and interests of the various human actors involved, as well as on how their political agendas were reflected in their actions and implemented in the technology, such as in technical interfaces. In parallel, I sought to understand the institutionalised relationships and power structures among the various human actors and organisations involved, and how they influenced the CPA's development. This approach further supports and asserts that the empirical case study approach is appropriate, because it investigates humans within their social context (Orlikowski and Baroudi 1991).

Inspired by Star (1999), my "reading" of how the CPA was built, focused on identifying and analysing the more unstructured and invisible work that was involved. While the CPA has been presented as the "success story" of the Norwegian network operators, my approach revealed that the CPA's emergence was highly complex and was not a process driven primarily by the network operators. Further insights were gained into local contingencies, the II's properties and the multiplicity of II builders and their respective achievements and contributions.

Because the domain studied was not an organisation in a traditional sense, but rather a business sector, my role as a researcher has been that of an outsider related to the involved organisations. While this can be limiting in a study of an organisation (Walsham 1995), it is problematic to define what is the inside and the outside of the CPA as the object of study. With a perspective on the surrounding business sector as being heterogeneous and rife with political struggles, being an insider to the business sector will at the same time suggest that researchers are outsiders to the involved organisations. For example, during the empirical work it became obvious that several informal relations existed between people from the different organisations involved in the CPA. By being an outsider and not being strongly associated with one organisation or with a particular interest or intention, I was in a position to get a more complete picture by being granted access, even if rather limited, to a range of the involved organisations and tracing these relationships.

Not operating within the borders of one or a few organisations was challenging also because I had to negotiate access and justify the interviewees' participation in a variety of different organisations, ranging from 5-person businesses to a network operator with 20,000 employees. While this required different approaches to gain access, maintaining access to all these organisations was not feasible. Another challenge was to identify the important people and organisations related to building the CPA, both historically and related to the business sector. To access this "hard-to-reach" population, a snowball strategy (Vogt 1999) was used both by explicitly asking the interviewees who else they recommended me to talk to, as well as receiving the interviewees' spontaneous recommendations. After several interviews, a list of the previous interviews was also shown to the interviewees to support this process.

### 2.1.2. Data collection and analysis

The data collected was primarily qualitative; it was, however, supplemented by "facts" about key actors, technical standards and the status of the technical implementations and common use. The data collection method across various sources was chosen because it is particularly useful in theory generation since it provides multiple perspectives on the case under investigation (Eisenhardt 1989).

A total of 39 formal interviews were conducted with managers, officials and system developers in a total of 23 different organisations, government agencies and forums

(listed in Table 2 below), including the two Norwegian network operators as well as the major aggregators. Some of the interviewees had a managerial role while also being a system developer and the head of sales, while others' roles have changed over time. The interviews typically lasted 45 minutes to an hour, which were all recorded and transcribed. Notes were also taken during the interviews. The interviews did not follow a strict interview format, and focused on the CPA's very nature, its development and operation, and the role of the interviewees in this. In addition to the interviews, data were collected from studying standard documents and specifications, websites and the trade press. For example, the CPA interfaces' specifications provided by the different network operators were compared, and I followed the ongoing debates concerning revenue share models and different attempts to break up the network operators' "monopoly" on mobile content services.

**Table 2: Interviews**

| Type organisation | No. of interviews |
|---|---|
| Network operator | 18 |
| Aggregator | 6 |
| Small content provider | 5 |
| Integrator | 2 |
| Forum/consortia | 2 |
| Government | 4 |
| Content producer | 2 |
| Total | 39 |

The data analysis was based on my interpretive perspective and on my capacity to conceptualise the data's essential topics. For example, the data were filtered through my understanding of the existing institutional context and of the involved actors' strategies. During the analysis, I broadly focused on the associated business sector's constituents and structures, the CPA's nature and components and the broader context of factors influencing its development. During the transcription of the interviews and based on my interpretations, key themes were identified and new perspectives and questions generated. These themes subsequently acted as inputs to discussions with co-researchers and interviewees and guided further analysis and interpretation of the transcripts. For example, as the important role of certain individuals within the various organisations involved in the building process became clearer, I discussed the importance of these people and their roles with other interviewees. This also encouraged me to identify and discuss with those involved in developing the CPA's predecessors. In parallel with this,

the research has been guided by continuous discussions with several co-researchers as well as by presentations at several seminars, workshops and conferences.

### 2.1.3. The role of theory

My research has been inspired by ANT which is widely used in II study (see for example Monteiro and Hepsø 2002) in the IS field (Rose et al. 2005). While it can be argued that using ANT as a lens in interpretative research contradicts ANT's fundamental ontological stances (Cordella and Shaikh 2003), I have not explicitly used ANT's language or emphasised its ontological implications (in line with Aanestad 2002). At the same time, even if I have not explicitly used ANT, it has indeed more tacitly influenced my research due to a prolonged exposure to its concepts and applications.

The ANT has guided my research primarily epistemologically related to my choice to study the process of II building as based on a complex actor-network. I have emphasised how technical networks and components, as well as other builders, influence the actions of the variety of the II builders. Building an II is thus seen as based on a negotiation process involving a heterogeneous and socio-technical actor-network (Allen 2004). My interpretation of the building process has been based not only on my interpretations of the interviews, but also on my interpretations of the roles of the various social and technical actors involved. In this way I have tried to make sense of how the II builders' interests and intensions were reflected in non-human components and further, how this was reflected in their use (for example Faraj et al. 2004).

The perspective suggested by ANT also has sensitised me to important aspects of IIs by focusing on how technology influences human behaviour (Monteiro 2000). It helped me to transcend technology and social determinism by focusing on the mutual influences of humans and non-humans. At the same time, my perspective was not restricted to certain analytical levels, but rather encouraged me to open those black boxes which I found interesting, and to close others. By using ANT in this way, I have also tried to avoid the risk of not being open to field data which a more rigid use of theory may introduce (Walsham 1995).

The primary contribution and output of this thesis is a theoretical framework of II building that extends the existing conceptual II framework presented by Ciborra, Hanseth and associates. Eisenhardt points out two important concerns related to building

theory from case studies (Eisenhardt 1989). First, the intensive use of empirical evidence may result in too complex theories. The data's volume and richness may result in theories that capture everything, but that lack an overall perspective. Information infrastructures are complex, and the way I conceive them suggests the use of several perspectives and concepts. In this thesis I have focused primarily on developing a concept of II building as an overall perspective, based on four existing concepts in the literature which I sought to extend. In doing so, the theoretical contributions are relatively parsimonious. Second, Eisenhardt argues that building theory from case studies may result in concepts which are idiosyncratic to the case at hand. A primary aim of this thesis was to develop a conceptual framework of II building for the business sector domain, and thus an extension to a more general theory, making this concern less pressing. At the same time, being embedded within this framework may be disadvantageous to the exploration of new concepts and theoretical ideas.

### 2.1.4.    *Studying IIs*

Prior research has focused on developing perspectives to better understand IIs as well as how to study them (e.g. Bowker and Star 1999; Star 1999). These attempts are close knit with an understanding of IIs as something underlying, invisible and out of sight; IIs are seen as being buried into practices, standards and technologies. This invisibility of IIs is deceptive, because it hides crucial social networks and practices. The way to comprehend IIs' invisible parts, is to submerge into "boring" (Star 1999) and sometimes invisible structures, to understand how these hidden factors shape the II and its usage. To unpack and open the black box of IIs to make the underlying social networks more visible has been termed infrastructural inversion (Bowker and Star 1999).

Star describes three "tricks of the trade" for studying IIs (1999) which have influenced and inspired my analysis of the CPA case. First she advises us to focus on the IIs' "others" by identifying master narratives and how they are used to make the "others" invisible and unnamed. Master narratives are used to merge actors and actions' diverse activities into monolithic agendas, and facts are made certain and stripped of the context of their development. From the very beginning of my study of the CPA, I consciously and carefully tried to identify the actors involved in the process of its building. This research approach resulted in a perspective on the process and the context by which the CPA came into being differently from the common understanding of its origins, in particular related to the role of the network operators.

This is closely related to Star's second piece of advice, which is to bring the invisible work to the surface. According to Star, unnoticed and formally unrecognised work is always going on, and not taking these activities into account will likely result in nonworking infrastructures. By studying how one of the network operators tried to internationalise the CPA, it became clearer to me that the CPA in Norway is not only about the efforts of a network operator, but also about content providers, aggregators, application houses, etc., and their coordination, negotiations, initiatives and spirit of entrepreneurship.

Third, Star advices us to investigate infrastructures' paradoxes. Why, for example, do small changes in routines prevent people from using new information systems? Exemplifying this paradox, Star underscores that work involving computers also involves the articulation work of bringing together computer resources, organisational routines and day-to-day tasks. Only by investigating both of these tasks we can understand why some information systems work and others do not. In the case of the CPA is an ongoing and heated debate about revenue sharing between network operators and content providers, and the network operators have been accused of taking too big a piece of the cake. While this could be taken as simply an expression of the content providers' perpetual chase for more money, as well as being unreasonable in perhaps *the* most thriving mobile content service market in the world, I have also found the content providers' complaints to be more deep-seated. "Reading" CPA as a technical standard or as a joint platform provided by the network operators could easily justify their share of the revenue, but would leave a false impression of what is going on here. In particular, content providers, aggregators and application houses provide the glue that keeps the CPA together. Not only do they pursue, develop and integrate into the network new and innovative services and service concepts, but they also facilitate the coordination and negotiation between the network operators. In this respect, those who do the job or take on the burdens are not really receiving what is for them a fair share of the benefits.

To understand how IIs are built and develop, we have to understand the components that compose and influence them. The network perspective of IIs challenges us in the sense that it becomes problematic to see what is part of the network and what is not. We may focus too narrowly on the achievements of one single organisation, or alternatively we might take a more universal perspective. At the same time, what I have experienced while studying the CPA is that it is very difficult *a priori* to understand the nature and

reach of the networks that influence II building. Only over time did this network's reach, both in space and in time, become apparent to me. Also engaging in a study of the CPA's internationalisation has been useful to help me to understand this network. When companies attempt to scale an II by implementing it in another context, it becomes clearer which components and actors are actually contributing to and constituting the II. While local breakdowns can make us discover our dependence on IIs (Star and Ruhleder 1996), studying the internationalisation of IIs can illuminate an II's essential components when the scaling processes break down.

### 2.2. *The case study: mobile content services in Norway*

The interest in capitalising on the mobile phone infrastructure by providing services to mobile phone users is increasing. This is due at least partly to recent developments in mobile devices (screen size, computing power, etc.), network infrastructure (multiple types of networks, higher bandwidth, etc.) and the increasing penetration of mobile phones into the consumer market. Recently many new services have been introduced to mobile phone users, such as text messaging (SMS), multi-media messaging (MMS) and data services (with GPRS[8] and HSDCS[9]). In Norway 3,65 billion SMS messages were sent in 2004, of which 494 million were mobile content services and 72 million were MMS[10]. In parallel with the increasing use of mobile services, the regulatory framework for service provisioning and the organisations involved in providing services also develop.

While mobile content services have been proven to be a sustainable business in Norway, these developments as a part of the "new economy", and with it the exponential growth of industrial activity and wealth, still have not met expectations in uptake and service variety (Kristoffersen et al. 2005). At the same time, while the commonly held prospect and significance of content services today are modest relative to the current GSM standard, the development of new and successful services is regarded as essential to secure growth and to justify investments in the next generation of mobile phone networks (3G or UMTS in Europe). While this necessarily will turn the network operators' focus toward content services, how they can best speed the development of

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[8] General Packet Radio Service.
[9] High-Speed Data Communication System.
[10] "The Norwegian Telecommunication Market 2004", The Norwegian Post and Telecommunications Authority, accessible from http://www.npt.no.

services and accelerate service uptake, is largely an open question. What role they will play in mobile content services in the future is also unclear. Thus, there is a growing need to better understand how these services come into being and develop over time.

### 2.2.1. *Merchandising and content service models of m-commerce*

Based on the developments in network infrastructure and user devices, mobile commerce (m-commerce) is a recent addition to existing services. In short, m-commerce is the transaction of goods and service with the support of a mobile phone. Two generic m-business models employed in the Norwegian market are briefly discussed here: merchandising based and mobile content services models.

Mobile phones today can be used as a mobile wallet or a cash-card. In Norway the network operator Telenor provides a mobile payment solution (Mobilhandel) to its customers based on agreements with a range of merchandisers. Telenor's mobile phone customers can buy cinema and concert tickets, use vending machines, buy DVDs, pay for parking, book airline tickets, play games, etc. Other companies (but not network operators) also provide similar solutions. For example, the company mPay offers services with which car owners can use their mobile phone to pay for or to extend parking rather than using coins in the parking meter. Payment for the services initiated by the customer is managed by mPay, and is performed in cooperation with banking institutions. Another service is Payex, provided by the company e-solutions, which is based on an electronic wallet. Where mPay and Mobilhandel charge service consumption directly to credit or debit cards, Payex's "electronic wallet" must be charged before use.

A special case of the above model is mobile content services. They are special in that they are limited to the transaction of services which are intangible, electronically transferable and consumable by the mobile phone. Further, these services are tightly integrated within the network operators' infrastructure. In particular, the payment for services as micro-transactions today is handled by the network operators' billing system and appears on the regular mobile phone bill. These services includes yellow pages, ringtones and logos, TV-interactivity (voting and chat), games, news, stock quotes, weather information, traffic information, horoscopes, jokes, etc. These content services do not support established and important organisational functions as most information systems do, but rather aim to provide innovative services of *any kind* as long as they sell. Creating new end-user habits and needs, these services primarily promote and support entertainment and leisure. The

services' nature as consumer goods has profound consequences. In particular, the development of usage and user communities is rapid and fairly unpredictable, hence significant uncertainty persists about future end-users' needs and end-user populations.

### 2.2.2. Mobile content service provision as "open garden" and "walled garden" approaches

In 1997 the two Norwegian network operators started to independently provide mobile content services to their respective customers. In addition to operating the technical platform, network operators marketed, administered and defined their portfolio of services. A primary purpose behind their service offerings was branding and differentiation (to retain and attract new customers), and thus was based on exclusive agreements with content providers. For example, Telenor has the exclusive right to provide logos, ringtones, games, etc. based on Disney characters (from Walt Disney Internet Group), while NetCom provides advanced weather forecasts for its customers in cooperation with The Norwegian Meteorological Institute. An alternative to these exclusive and "walled garden" approaches to service provision is public and market wide service offerings. The CPA platform is an illustrative example of such an approach, offering Norwegian mobile phone users market wide access to content providers. Further, the content providers are allowed to freely provide new services and to develop service concepts, freeing network operators of administrative burdens and further development of the infrastructure.

The CPA was introduced as a response to existing problems with "walled garden" approaches in Norway. On one hand, marketing is expensive for network operators, and due to limited revenues, such expenses were hard to cover. Providing services to only a portion of the relatively small Norwegian market makes this even more problematic. On the other hand, the network operators were under strong public scrutiny. As an example, when a service for drink recipes on SMS was criticised for encouraging alcoholism it was immediately closed down. The actors involved in mobile content services found this as a strong indication that the network operators were not necessarily those who should provide services directly.

The CPA's architecture enables mobile phone users to acquire services through some simple steps. For example, if a user would like to know the phone number of a friend John, she first locates the required information for ordering the service (for example, on

the web, in a magazine or on a banner). A short-code (a phone number with only four digits) identifies the content provider. As a request for the content, the user sends an SMS containing the content item's name or code from her mobile phone, in our example simply the text "phone john" to, for example, the number 1905 (step 1 in Figure 1 below).
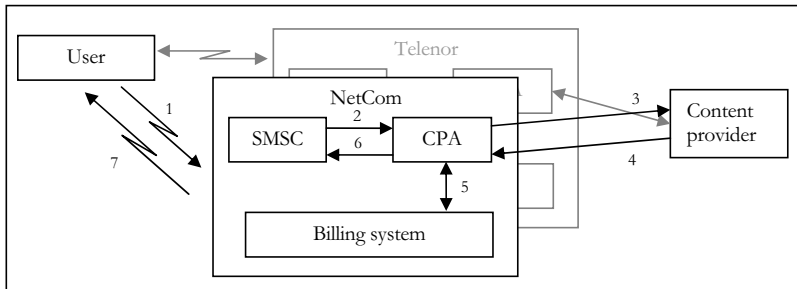


**Figure 1: Content service request and delivery on the CPA platform**

As an ordinary SMS, the message is handled by the SMSC (message centre) in the customer's operator's network (in our example NetCom). When the short-code 1905 is recognised, the request is forwarded with the user's phone number to the technical CPA platform implemented by the network operator (step 2) (the network operators' technical implementations of the CPA are independent and highly idiosyncratic). The CPA platform then forwards the content of the SMS over a TCP/IP connection to the content provider associated with the number 1905 (step 3). When the content provider receives the request, "phone" and "john" are recognised as the service requested and its input, respectively. The content provider then produces and returns the proper content (which in this case is simply a phone number) to the network operator by the TCP/IP connection (step 4). When returning the content, the content provider also has the responsibility to rate the services according to predefined (by the network operators) rating classes ranging from Norwegian Kroner 1 to 60. Upon receipt, the network operator requests its billing system with a CDR (Call Data Record) to handle the request according to the rating class (step 5), and if successful, the content is delivered to the customer by the SMSC (step 6 and 7). Because the user is already registered with the network operator, there is no need for registration and confirmation of personal data, credit card numbers, etc., and payment for the service will simply be handled over the regular mobile phone bill. Finally, when the user pays his phone bill the revenue is split between the network operator and the content provider.

The "walled garden" and CPA approaches are similar in the sense that they provide an infrastructure for third parties to provide mobile content services. At the same time, their strategic foundations and operational approaches differ significantly. While the CPA has been attributed little strategic value by network operators, the "walled garden" approach has. And because of its greater strategic importance, more resources have been invested in service development, marketing and administration of "walled garden" approaches than with CPA, such as the case of the Japanese i-mode standard (Nielsen and Hanseth 2005). In stark contrast, these responsibilities are distributed among a range of actors related to CPA. In particular, procedures to introduce and administer services and the responsibility for marketing and service innovation, rest with content providers, application houses and aggregators. This redistribution of roles and responsibilities also involves the redistribution of control and risks. For example, the editorial responsibility (and its risks associated) for content services provided over the CPA does not rest with the network operators, but with the content providers.

## 3.   RESEARCH FINDINGS

This thesis draws upon six papers published in conference proceedings and journals. These papers are from different stages in my Ph.D. study, and have been written with different authors and for different outlets. Related to the research aim outlined in Chapter 1, three of the papers both explicitly develop conceptually on the existing II conceptualisation and provide empirical insights into the CPA case. Paper three discusses II as a conceptual framework, but draws upon another case study, while paper five and six on the contrary discusses CPA without explicitly using the concepts of II. The papers' titles are as follows:

   I. Implementing Public Platforms for Mobile Phone Content Services: Standardization in an Era of Convergence

  II. Internationalization of Information Infrastructures and Control: Cases from Mozambique and Norway

 III. Theorizing Convergence: Co-Evolution of Information Infrastructures

 IV. "Ordinary Innovation" in Nomadic and Ubiquitous Computing: the Need for Alternative Theories in an Emergent Industry

  V. Infrastructuralisation as Design Strategy: a Case Study of a Content Service Platform for Mobile Phones in Norway

 VI. Open Standards for Mobile Content Services: a Case Study of the Norwegian CPA Standard

With different foci, and being written simultaneously with the collection and interpretation of empirical data, these different papers reflect a "maturing" of insights, ideas and concepts. The different papers also point at different sides of the case as the research's focus has developed. At the same time, a continuous thread throughout the papers is the discussion of the complex process of II building. The papers' empirical findings are also drawn upon in chapter 5, where the extended conceptual II framework suggested in this thesis is applied and discussed in relation to the CPA case. Each paper's contents and findings are summarised in short abstracts in the following.

### 3.1.    Implementing Public Platforms for Mobile Phone Content Services

This paper seeks to understand how the CPA is interrelated with and influenced by ongoing processes of convergence. The CPA is illustrated not as the result of formal and technical standardisation, but as being built on the ongoing, *ad hoc* and rather minimal coordination among mobile phone network operators and the other actors involved as the market for mobile content services emerges. Its development unfolds outside the institutional framework of standardisation organisations in an unregulated and unrestricted area, and thus brings to the field a range of new actors. The result of this process is not only of a technical kind, but is found in the different layers of standards which support mobile content services; coordinated business models and roles related to billing services, marketing and branding; and transparent access to infrastructure and services for content providers and mobile phone users.

By understanding the CPA as an II, this paper identifies and describes new approaches to standardisation, as well as new kinds of standards within telecommunications. Discussing CPA development as unfolding within, and as a part of ongoing processes of convergence, openness and flexibility is described as both challenging for those involved as well as vital for standardisation processes. It is open in the sense that a range of different actors and organisations are allowed to take part in its development, but as a consequence no one fully controls its trajectory. It is flexible in the sense that it emerges outside the scope and central control of standardisation organisations and their practices, and can accommodate services susceptible to changes in trends, hypes and media events.

The paper contributes by showing how the CPA emerged as a process where different and heterogeneous actors, as well as markets and technologies, came together, a process bringing not only synergies but also confrontations. In this context diverse actors with different and sometimes conflicting agendas, powers, needs and incentives influenced the trajectory of standardisation processes. Because the standardisation process was open, participation and setting the agenda were fragmented and distributed among the involved actors. The paper also points out how alternative approaches based on technical standards would have required more extensive coordination between the network operators, which would have been difficult due to their fierce competition and differences in their installed bases. At the same time, openness and flexibility in standards

and standardisation processes and the way they are reflected in the lack of formal and technical standards, make content providers more dependent on mediators.

### 3.2. *Internationalization of Information Infrastructures and Control*

This paper concerns the internationalisation attempts pursued by one of the Norwegian network operators to implement the CPA in its internationally dispersed affiliates. At the same time, it examines a different internationalisation attempt of a computerised health information system for developing countries (DHIS), more particularly in the case of Mozambique. The goal of this paper is to provide a better understanding of the process of scaling complex and heterogeneous information systems by using II as an analytical lens with a particular focus on control.

By studying the process of its internationalisation, several of the CPA's salient features are illustrated. In particular, the CPA appears as a platform based on bottom-up initiatives and coordination among network operators as well as a range of other actors such as content providers. The Norwegian network operator involved in internationalisation did not fully control the process by which CPA developed in Norway in the same way as its affiliates when attempting to implement the CPA in their local context. The cooperative environment and ties influence the CPA's implementation and success both as a global-local process between the network operator and its affiliates and on the local level for the affiliates.

In comparison the two cases illustrate that internationalisation can be pursued based on a product as in the case of DHIS, or on a process as in the case of the CPA. Internationalisation of products, such as software, requires a certain flexibility to accommodate the changes that are required to make the product useful across different contexts. When internationalising processes that describe how to develop and implement, the same challenges occur. And where standardised processes may lead to non-standardised products as the process unfolds in the local context, being sensitive to the contexts is, in both instances, necessarily at the cost of standardisation and universal control. The lack of control over local implementations and their failure from a universal perspective thus should not be attributed to the internationalisation process alone. In particular, the network operators trying locally to implement the CPA may face even more restrictions on their ability to control than those pursuing universal standards. Involving and coordinating the different actors required for the CPA locally assume not

only their existence, but also their willingness and initiative to participate in the dispersed and emerging building process.

The paper draws implications related to how information systems always have to be adjusted and tuned to the local context in which they are implemented. We must at the same time accept that IIs are not always "compatible" with every context. This also underscores how the CPA is linked with its context and how difficult, if not impossible, it is to draw the borders of its installed base. The paper suggests approaching internationalisation through a blend of standards and more informal relations among the involved actors to control and preserve standards, and to support local building activities.

### 3.3. Theorizing Convergence: Co-Evolution of Information Infrastructures

This paper is based on a case study of the convergence of the mobile communication platforms UMTS[11] and WLAN[12] in Norway from 2002 to 2004. The paper's aim is to develop a theoretical framework of IIs' co-evolution to better understand convergence processes as well as IIs in general. The paper departs from the view that convergence is a core building block for the Information Society and for *e*Europe, and is the expected result of strategic moves such as deregulation by governments across Europe. It shows how convergence processes on the ground in general are utterly slow. This is not attributed to a lack of or failing strategising or intervention by governments, but is described as a result of IIs' installed bases, their inertia and evolutionary character.

To better understand and capture convergence's slowness and lack of progress, the paper contributes by suggesting a process-oriented perspective on co-evolution by conceptualising communication platforms as IIs. Co-evolution is discussed as the parallel and simultaneous evolution of distinct, still interrelated IIs. This process is intrinsically related to the involved IIs' installed base; for example, their developers' institutionalised approaches to developing and implementing technical platforms. Rather than assuming convergence as a given result, convergence is understood as only one among several possible outcomes of co-evolution (such as, for example, divergence).

Applied to the case of UMTS and WLAN, the co-evolution perspective illustrates how their installed bases mutually influence each other to shape the trajectory of co-evolution.

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[11] Universal Mobile Telephone System – the next generation of mobile telephony in Europe.
[12] Wireless Local Area Network – wireless extensions of local area networks (LANs).

Conceptually distinguishing between the *demand-side* of installed bases, composed of the users' preferences, practices and investments, and the *supply-side*, composed of the ICT providers' investments and preferences related to design, implementation and diffusion, multiple factors across several dimensions (network, terminal, services and market) are illustrated as influencing each of the platforms' evolution and co-evolution. While not excluding the possibility of convergence in the future, this paper's findings point to the need for extensive coordination and negotiation to iron out inconsistencies and antagonisms for convergence to happen. This process is of a political nature, and certain key actors (controlling key elements of the installed base) have the power to influence the trajectory of developments, and thus speed up or slow down convergence processes. Convergence thus requires the reconciliation of several actors and forces, and thus requires an adequate understanding of the involved IIs' demand- and supply-sides. This includes issues such as the inertia of investments in technical components, different organisational and market structures, diverging approaches to design and implementation of platforms and existing end-user preferences and practices related to the different IIs.

### 3.4. *"Ordinary Innovation" in Nomadic and Ubiquitous Computing*

This paper draws from the CPA case study, a case of a mobile content distributor (MultimediaContent.com) and a mobile phone payment solution (mPay). With a broader perspective than only the CPA, the paper shows how the visions of, and the investments in m-commerce are challenged by a current lack of demand for mobile services, and argues that innovation in the mobile service area is focused primarily on avoiding risks. The radical and disruptive innovations that were supposed to change this industrial landscape are largely missing.

The network operators' approach to providing the CPA is described as complex and not completely open. In particular, content providers must cross a high threshold to enter this market due to its limited revenues, because of the value network building up including actors such as content producers, aggregators, application houses, integrators, network operators and media windows. It is pointed out that the network operators' revenue share will always be contested by their counterparts such as content providers, but it is not favourable to network operators only in monetary terms. Network operators are also farming out risks, further technical development and innovation. The existing

structures between the actors, such as standardised agreements and interfaces and ongoing coordination activities, reinforce this situation.

As a more general insight, acquisition and distribution services are identified as important components related to mobile content services and control. For example, while network operators are delegating a range of roles to other actors, they at the same time actively retain control over their physical infrastructure and their customers. In all three cases presented, the various actors involved in mobile content services are at the same time pursuing strategies of risk reduction. They participate by providing one part of a larger offering to reach a wide market and to share the risk of innovation and marketing to secure a cash flow and for some, to simply keep going. Following the latest hype, these actors are focused primarily on creating revenues from what they already have. As part of a value chain, they all strategise locally which, in sum, leaves neither the willingness to create nor room for "disruptive" innovations.

Disruptive innovations have been discussed as innovations which cannot be performed by incumbents trapped in their old regimes and relationships with their customers. These innovations can originate only from lean and flexible organisations. The findings in this paper point out that within the current context of mobile content services, none of the actors seems to have the will or possibility to make such innovations. This is primarily because of the incumbents' local optimising strategies related to payment/billing solutions, transportation systems and content production, as well as the content providers' day-to-day struggle. The paper calls for new concepts and theories to capture this context of "ordinary innovations" to describe and better understand the development of mobile services.

### 3.5.   *Infrastructuralisation as Design Strategy*

This paper focuses particularly on the network operators' approach and decisions to introduce the CPA. Historical and contextual influences on the CPA's development, as well as its final shape, are portrayed and discussed. In particular, this paper questions the argument that lack of control is necessarily a challenge by describing the CPA case as an example, in which control was delegated rather than pursued. Instead of simply focusing on control, the network operators found a fine balance between control and delegation of control by allowing actors internally and externally to autonomously pursue their own interests. Through this process, which we term *infrastructuralisation*, a more appropriate

approach than previous ones related to mobile content services was followed. In particular, it was better suited to the prevailing availability of resources and to the distribution of abilities and willingness to take risks and to innovate. In doing so, the network operators opened up their previously closed and exclusive platforms for mobile content services and ceded control to let themselves become only one part of a larger II.

This paper empirically illustrates how network operators managed to shape an II to suit their values and needs. Based on experiences with content (voice based) services for fixed line phones (Teletorg) as well as proprietary platforms for mobile phones, both network operators and content providers were searching for an approach better suited their current situation. For network operators with strong brands in Norway, being in control had previously required them to restrict content to utility services only. At the same time, the network operators' lack of market knowledge related to content services, their high cost of marketing, the limited size and revenues from a segmented market and utility services, and the lack of their attention and willingness to invest in content platforms acted as inputs for initiating a different approach. While the network operators clearly saw the need for change, content services were still seen only as value adding. And without a good business case, there were limited support and resources. The network operators' efforts related to the CPA therefore were based only on reusing existing technical components, not on going through the regular channels of systemising, and were based on the limited resources which a few enthusiasts on the operational level managed to gather. At the same time, several external content providers were pushing for its launch and were ready to provide new services and service concepts.

The CPA's shape can be explained by the configuration of control and autonomy on different levels. In particular, employees at the network operators' operational level had the autonomy to pursue personal initiatives. The CPA emerged as a result of their eagerness and design choices and the way they implemented them by avoiding the legacy of the billing system and the regular approach to develop new services. At the same time, the content providers exercised external influence and got the opportunity to autonomously introduce and provide new services. Infrastructuralisation is thus a strategy related to an appropriate balance between control and autonomy. Striking this balance requires a deep understanding of existing actors, and of their ability and willingness to take risks and to innovate.

### 3.6.    *Open Standards for Mobile Content Services*

This paper focuses on how contemporary standards and standardisation processes are changing. More particular, it discusses standards' openness and flexibility, as well as the flexibility of standardisation processes in m-commerce. The paper illustrates the CPA as being based on a "package" of standards containing more than technical standards enabling interoperability. In particular, to make things work, it also contains a standardised business model, network operators providing standardised functionality and service level for content providers, coordinated administration and use of rating classes and short numbers, guidelines for consumer protection, and a standardised interface for service acquisition.

The CPA's emergence is described as unfolding in an environment of scarce resources, but employees working for network operators took the opportunity to pursue local initiatives. By doing so, they avoided grand marketing campaigns, changes in billing systems and postponed time consuming systemisation and documentation. At the same time, content providers and aggregators took initiatives and developed add-ons and extensions to the platform enabling new services and service concepts.

To illustrate how the CPA is interrelated with its context, examples from attempts by one of the Norwegian network operators to implement the CPA in other countries are also drawn upon. Three salient issues challenging local building processes are described: the "open garden" approach may be too controversial because of the possibility of retention of customers and the risk of losing control, a particular and historically unconventional approach to billing is required to be implemented, and, perhaps most important, the CPA standard has to be accepted across the market. In the case of Norway, however, network operators did not see content services as strategically significant, a range of content providers already were urgently seeking new outlets for content services, and strong ties exist on the operational level across the relatively small market.

Comparing the CPA to alternative and proprietary standards, in particular, to the Japanese i-mode standard, this paper argues that the CPA provides a better environment for innovation, diversity and the development of content services in general. In particular, proprietary standards will be limiting because network operators define the service portfolio and operate the bureaucracy it creates. Further, several findings related to the CPA as a standard are discussed: how it is *open* related to architecture and standardisation

process, how it is *complete* in the sense that it covers the necessary aspects the actors need to agree upon, how it is *simple* in the sense that only a minimum was specified, and how it is *informal* in the sense that it is not based on formal standardisation processes and technical specifications. In sum, these characteristics make the standard *flexible* and *robust*. The CPA is flexible in the sense that it can accommodate changes in a highly unpredictable market, and robust in the sense that a range of different actors can make the required changes. By disclosing one instance of the transformations in the "world of standards", this paper contributes by underscoring the important roles of open standards, how they may be developed and how they may appear related to m-commerce

### 3.7.    Linkages between the papers and inputs to the theoretical framework

The papers' empirical findings and conceptual contributions have been briefly introduced above. To point out how the papers contribute conceptually and empirically to the extension of the existing II conceptualisation developed in this thesis, some of the linkages between the papers and how they contribute conceptually are briefly illustrated in Table 3 below. The linkages are illustrated by relating them to the concepts of heterogeneity, control, standards and evolution.

Table 3: Conceptual contributions and empirical insights from the papers

| Concept | Paper No. | Conceptual contributions and empirical insights |
|---|---|---|
| Heterogeneity | I | Various political agendas and confrontations are involved when various IIs are influencing each other |
| | III | Heterogeneity is an issue on both the demand- and the supply-side of IIs, involving the preferences, practices and investments of their developers and end-users |
| | VI | A range and variety of human and non-human actors are involved in the CPA's development. The need for, the multiple roles of and heterogeneity as something to be capitalised on |
| Control | II | Different aspects and balances of control and how control is a global-local as well as a local issue |
| | IV | The significance of and politics related to controlling the various components in the value chain, and how strategies result in local optimising strategies and "ordinary innovations" |
| | V | Control and autonomy are inseparable aspects on several levels and their balance is based on different actors' strategies, their resources and their abilities and willingness to take risks and innovate |
| Standards | I | Different layers of standards are needed and a variety of actors are involved in standardisation |

| | | |
|---|---|---|
| | IV | Interdependencies between actors involved with mobile content services create a need for coordination, and coordination reinforces existing structures and shapes activities such as innovation and the architecture of the business sector in general |
| | VI | Standards are more than technical specifications enabling interoperability; they are packages playing a range of different roles to make things work, and particularly influencing flexibility and innovation |
| Evolution | II | There is a tight relationship between IIs, the way they develop and their context related to existing IIs, actors and institutions |
| | III | While the installed base on the supply- and the demand-sides strongly influences the trajectory of IIs, actors in key positions may still take (political) actions influencing the trajectory of IIs |
| | V | The CPA was based on and was a continuation of previous content service platforms and existing relationships between the actors in the market, their technical arrangements and ownership of users, but also was discontinuous by, for example, bypassing network operators' existing approaches to development |

## 4.   THEORY: RELATED RESEARCH AND A FRAMEWORK OF II BUILDING

This chapter introduces and develops on the concepts of *heterogeneity*, *control*, *standardisation* and *evolution* in relation to II. To contextualise the discussion, the first part outlines these concepts as they have been characterised by Ciborra, Hanseth and associates. The second part proposes, based on the empirical findings and conceptual contributions of the papers summarised in chapter 3, suggestions for extending and enriching the existing conceptualisation of Ciborra, Hanseth and associates (referred to from now on as the existing conceptualisation). A synthesis of the individual theoretical extensions is finally integrated into my proposed theoretical framework for understanding the process of II building in section three. This theoretical perspective is applied to the analysis of the CPA case in chapter 5 to illustrate its applicability.

### *4.1.   Related research: the existing conceptualisation of II*

My point of departure is the existing conceptualisation of II by Ciborra, Hanseth and associates. In this section I provide a brief overview of how the concepts of heterogeneity, control, standards and evolution have been characterised.

#### *4.1.1.   Heterogeneity*

While "traditional" information systems can be characterised as being closed and having a specific purpose for a limited number of end-users, IIs serve a wide range of users, user communities and types of applications. At the same time, IIs are composed of technical equipment and software as well as the people who design and implement them, use them and train others to do so. Thus IIs include components such as computers and humans, as argued by Hanseth and Lyytinen:

> *"… information infrastructures are at any moment of time heterogeneous: they contain components of multiple sorts – diverse technological components as well as multiple non-technological elements (individual, social, organizational, institutional etc.) that are necessary to sustain and operate the infrastructure."* (2004, p. 9).

Heterogeneity thus concerns both materiality and diversity; i.e., IIs are composed of social and technical components, and each of those components' diversity.

The *heterogeneity* of IIs has been conceptualised as one of their fundamental characteristics, and as a primary challenge for their developers. The complexity of heterogeneous networks develops over time and builds on existing infrastructures, so changes must relate to this installed base and unfold with evolution. Heterogeneity thus shapes how IIs develop, and coordinating diverse components in developing IIs becomes essential. Controlling heterogeneity is seen as requiring precise interfaces, standard families and related protocol stacks (Hanseth and Lyytinen 2004; Lyytinen and Yoo 2002).

### 4.1.2. Control

Control, or rather the lack of control over technology, has been described as another important distinction between information systems and IIs (Ciborra et al. 2000; Hanseth and Monteiro 1997). As a consequence of IIs' different components' dispersed and distributed ownership, lack of control is a fundamental mechanism of II as it leaves the developmental activities to deal only with portions of the II (Hanseth and Lyytinen 2004; Hanseth and Monteiro 1997). The rest of the II will be controlled and developed by other actors who are out of reach and out of central control (Hanseth and Monteiro 1997), thus multiple actors are involved in shaping the trajectory. Control of IIs has been discussed around the relationship between global control and local flexibility (for example Ciborra et al. 2000; Ives and Jarvenpaa 1991; Rolland and Monteiro 2002). The need for centralised control is at odds with the need for local flexibility, and managing this balance is influenced by IIs' diffusion (Hanseth et al. 1996) and by the inevitability of situated practices (Ellingsen and Monteiro 2003).

The existing conceptualisation of II is critically dependent on the issues of control based on the argument that technology itself is not necessarily under central control (for example Ciborra 2000a; Hanseth et al. 2001). Strategies toward strengthening managerial control in organisations with IIs may thus result in curbing rather than strengthening control. Implications have further been drawn, related to how IIs may exercise boomerang- or side-effects rather than support the aims and strategies of those who seek structure, efficiency and control (Ciborra et al. 2000). Therefore, being out of control is one of the fundamental issues challenging II developers.

### 4.1.3. Standards

Due to the components' heterogeneity and dispersed nature, and IIs' networked nature, standards are essential building blocks (Hanseth 2000; Hanseth et al. 1996). In particular,

interoperability standards play a crucial role in coordinating and linking the multiple and diverse components which constitute an II. An alternative approach based on bilateral agreements will be all too expensive and will result in independent connections rather than an II (Hanseth 2000).

While standards create the glue that holds the IIs together, the spread of IIs across various settings also requires sensitivity to local contexts by allowing local and situated practices to continue (Rolland and Monteiro 2002). At the same time, as standards diffuse, more radical changes become difficult centrally to implement and diffuse because the users are distributed and are not under central control – the standards become cumulatively more change resistant (Egyedi 2002; Hanseth et al. 1996). This nature of standards and mechanisms through which they develop has been labeled the economy of standards (for example Besen and Farrell 1994; Shapiro and Varian 1999) and the "battle between systems" (for example Abbate 1994; David and Bunn 1988; David 1985). Strategies such as gateways have been proposed as an approach to overcome the challenges of multiple and co-existing technical networks (Hanseth 2001). For example, in the late 1980's a computer network was established between the universities in the Nordic countries called Nordunet (Hanseth 2001). While different network protocols were used across the universities (OSI/X.25, EARN, DECnet, and ARPANET/IP), the "Nordunet plug" enabled a multi-protocol network by acting as a gateway providing access to a shared backbone.

Technical standards have been conceptualised as being necessary to keep an II together by creating the necessary interoperability between dispersed and heterogeneous components. Creating demand-side economies of scale, standards at the same time create lock-ins and become change resistant over time.

### 4.1.4. Evolution

Because of an II's open, complex and networked character, any development project will cover only parts of it, which implies a different kind of process, and requires different approaches from those described in textbooks on system development (Hanseth and Lyytinen 2004; Hanseth and Monteiro 1997). An alternative perspective based on the *evolution of the installed base,* and the fundamental roles the installed base plays in development processes has been argued as being more appropriate (Ciborra et al. 2000; Hanseth and Monteiro 1997). Evolving and evolution do not imply that IIs develop via

"natural selection", but describe change as a step-wise, small-scale and incremental process. An II is never built from scratch – it is always an extension of what already exists (Hanseth and Lyytinen 2004; Star and Ruhleder 1996). Evolution is thus less radical, appearing as integration, extension, and the replacement of existing components of the installed base (Ciborra and Hanseth 1998).

Several authors have suggested the concept of *cultivation* to illustrate a strategy to influence technological development as an evolving installed base (Bergqvist and Dahlberg 1999; Ciborra et al. 2000; Dahlbom and Mathiassen 1993; Aanestad 2002). For example, Ciborra (2000a) depicts cultivation as an approach fundamentally different from rational planning and controlled design processes. By pointing to their internal dynamics and the role of IIs as not being "passive" and neutral, cultivation is about: "… interfering with and support for a material that is in itself dynamic and poses its own logic of growth …" (Ciborra 2000a, p. 31). A cultivation strategy is therefore discussed as a way of dealing with IIs which evolves autonomously and thus is largely not subject to centralised control. Referring to the economic mechanisms of networks in general, concepts such as installed base, momentum, irreversibility, increasing returns, network externalities and path-dependency are central in understanding evolution (Hanseth and Lyytinen 2004). The installed base's conservative power, its resistance to change, and its irreversibility have profound effects on developments in imposing an incremental nature of growth.

Table 4 below briefly summarises the characteristics of the four concepts. The next section discusses and proposes suggestions for extending and enriching each of them.

**Table 4: A summary of the existing II conceptualisation**

| Concept | Characteristics of existing conceptualisation |
|---|---|
| Heterogeneity | *IIs are heterogeneous networks*<br>- Socio-technical and diverse components<br>- Coordination with technical standards is essential |
| Control | *IIs are out of control*<br>- Multiple and dispersed actors involved in shaping the II<br>- Introducing II may curb rather than strengthen control |
| Standards | *IIs are organised by standards as essential building blocks*<br>- Interoperability standards keep IIs together<br>- Standards become change resistant over time by creating lock-ins |
| Evolution | *IIs are developing as an evolving installed base*<br>- IIs are evolving and autonomous<br>- Development activities have modest influence on IIs and are limited to strategies such as cultivation |

### 4.2. An extended conceptual framework to understand II building

While the II conceptualisation described above provides a highly useful starting point to understanding the building of an II, it also has some important limitations. In particular, it portrays IIs as autonomous and as leaving developers simply with the ability to cultivate. At the same time, the multiplicity of its developers and their interrelationships are not addressed. As a consequence, human agency, the multiple agencies of the different builders, and institutions' and IIs' roles in shaping agency, and the relationships between the various actors have arguably been under-theorised. In contrast with the increasing recognition of human agency over information technology and its related social structures (Boudreau and Robey 2005), the knowledge and capability (Giddens 1984) of II builders to make change is downplayed. This section provides suggestions for extending and enriching the existing conceptualisation to capture these issues. While the concepts discussed in the following are intrinsically related, it makes sense from an analytical point of view to discuss them separately. I also argue that treating these concepts as a "conceptual package" of IIs is problematic, because heterogeneity does not necessarily imply lack of control, lack of control does not necessarily imply evolution, etc.

#### 4.2.1. The different roles of heterogeneity in II building

The concept of heterogeneity may lead us to assume that the II building process is chaotic. I argue for the need to place equal emphasis on heterogeneity as an asset and on the structures, institutions and activities which seek to create homogeneity and to frame the building activities, and thus the II's very shape. More particularly, I make a conceptual distinction between the demand- and supply-sides of IIs and draw upon the concepts of "system builders" and institutions.

Researchers have used network economics to explain how an II's growth depends on its capacity to be *enabling*. An II is not built to support one particular application, but a wide range of usages and activities (Hanseth and Monteiro 1997). Therefore IIs need to be open and to embrace heterogeneity of users, usages and applications. The paradigmatic example of such development is the Internet and the way it has enabled and encouraged unanticipated usages (Abbate 1994; Abbate 1999). Another viewpoint on II is to focus on the need for local adaptations as well as universal solutions (Ellingsen 2004; Rolland and Monteiro 2002). Introducing an II to an organisation, requires a balance between curbing complexity, reducing risk and standardising on one hand, and the necessity of local and

context based adaptations on the other. In advocating a "pragmatic balance" as a solution to this contradiction, it is hoped that developers will make explicit the end-users' hidden work or the "costs" associated with establishing an II (Rolland and Monteiro 2002). At the core of the balance between enabling and controlling in shaping IIs' heterogeneity is the openness of standards (Nielsen and Hanseth 2005). One way of defining open standards, is that their specifications are publicly available (Funk 1998; Funk and Methe 2001). But this openness in terms of the specifications' availability can also come with a hybrid approach whose strategy is to achieve returns by opening only parts of the standard and disclosing the standard only under certain restrictions. This perspective points to openness as being not binary, but rather of degree, as well as involving economic and political interests and influencing heterogeneity.

While standards are a means to reduce heterogeneity, an II paradoxically grows due to a variety of different and heterogeneous applications and usages. At the same time, IIs do not indiscriminately allow for just any kind of heterogeneity, as applications and innovations have to be implemented according to certain conventions. For example, wireless telecommunication equipment must comply with national and international regulations regarding frequency usage and signal strength. These constraints may act as burdens on the creative process of innovation in the exploration of new commercial ideas. The nature of IIs as "commons of innovation" will in particular be determined by control structures that strongly influence what is possible to build upon them (Lessig 2001).

The existing conceptualisation of heterogeneity points to at least two different issues: heterogeneous materiality and diversity. Distinctions between these issues are rarely made in the II literature, even if phrases such as "heterogeneous and complex" and "heterogeneous and diverse" often are found which implicitly point to a *socio-technical perspective* and to the *variety* of technical as well as social components. The difference between material heterogeneity and diversity is significant in the building of an II. On one hand, material heterogeneity relates to how the II's constituents are understood – appreciating both technical and social components as the II's constituents. On the other hand, diversity is the inherent nature of II and its various components such as network protocols and different institutionalised standardisation practices. While discussing building related to the degree of diversity is useful, it does not relate to the heterogeneous

materiality. Material heterogeneity becomes ubiquitous when accepted as a perspective. Diversity will, on the contrary, vary in degree and kind across different IIs. I thus use the term *socio-technical* to describe heterogeneous materiality and *heterogeneity* to describe diversity of technical components, practices, usages, etc. While I adopt a socio-technical perspective, I primarily discuss this concept of heterogeneity in the latter.

*Demand- and supply-side perspectives on heterogeneity*

An II is based on the interconnection of networks, necessarily involving the negotiation of technical, social and political aspects. Even if standards or builders in control may rule out some of the diversity when exercising their power, heterogeneity is likely to prevail. This is related both to the II's *demand-side*, i.e., end-user preferences, practices and investments, and to the *supply-side*, i.e., the ownership of technical components and the investments and preferences related to design, implementation and diffusion (Jansen and Nielsen 2005). Figure 2 below illustrates how II's existing conceptualisation differs from, but also is related to, the perspective of II building I argue for here. In particular, the existing conceptualisation is based on *some* builder of an II who should be informed, reasonable and should take the various implications and consequences of heterogeneity into account. For example, Hanseth and Aanestad (2003) suggest strategies to make designers carefully sort out key users, use areas and technologies. These challenges and conflicts are, however, discussed only around the "user-developer" axis. As illustrated in Figure 2, the "user-developer" perspective focuses on the relationship between the users (u) and the II (implicitly including their developers).
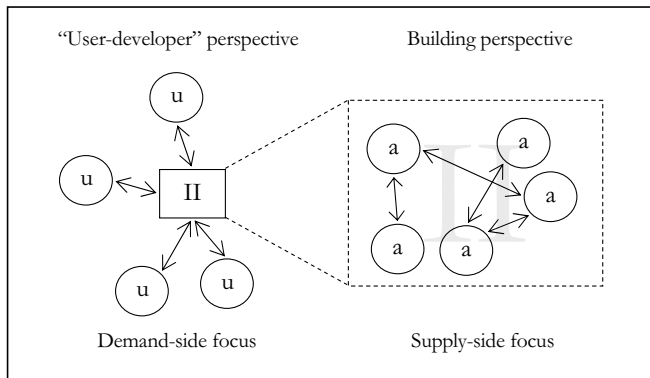


**Figure 2: Perspectives on heterogeneity**

The building perspective taken here helps to open the black box of building. It focuses on the relationships between the socio-technical and heterogeneous actors (a) participating in and influencing on the building activities on the supply-side. Based on this, the "user-developer" perspective becomes only one among several heterogeneities which are influential on II building. The various builders involved do not necessarily share aims, values and interests, and are likely to pursue diverging and competing agendas. Conflicts and challenges thus appear on the "builder-builder" axis. As a part of this building process, the multiple builders not only have to integrate their technical components, but also have to become integrated. With ownership and control over central technical components or user populations, certain builders will have the power to influence and shape this integration process. For more peripheral builders, this exercise of power can be welcome as it creates a common ground, but can also be coercive when the result appears to favour those in power and control. The challenges of building an II thus include the heterogeneity of its builders, their interrelationships, central and peripheral builders and roles, and how these influence the building process.

*Central roles in II building and the "system builders"*
Based on his work on the history of the electrical system in the US, conceptualised as a large scale and socio-technical system, Hughes coined the term "system builder" (Hughes 1979; Hughes 1987). Hughes showed how this electrical system was not only technical, but also was related to and based on various institutions, manufacturers and investors. Such systems cannot satisfactorily be treated in isolation from organisational, political and economic matters, but must be integrated with their context to work and to grow. To facilitate this is the key role of the "system builders" – the creators of large-scale and socio-technical systems. "System builders" preside over technological projects from the concept and preliminary design stages through research, development and deployment. In order to do so, they need to cross disciplinary and functional boundaries and become involved in funding and political stage-setting. The core competency of the "system builders" thus lies in their ability to integrate heterogeneous physical, human and organisational components into a working and goal-oriented system: " … to force unity from diversity, centralization in the face of pluralism, and coherence from chaos." (Hughes 1987, p. 51). According to Hughes, "system builders" should have a holistic focus and see the entire system, rather than only its components. Through control and management, and with attention to the interconnection between the system's different

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components, "system builders" believe that the system will not evolve and grow without someone viewing it as a coherent system.

Hughes draws our attention to the lack of boundaries between IIs and their context. He does not, however, develop in depth his concept of "system builders." For instance, the differences and relationships between the "system builders" and "their associates" are unclear. Hughes' use of the military metaphor *reverse salients* is also problematic as it draws attention to the "system builders" confrontation with: "unavoidable confusion, flux, and partial information of the battlefield …" (MacKenzie 1987, p. 197). But agreeing upon what constitutes a barrier to progress necessitates agreement on what we are trying to achieve in the first place. Hughes thus bases his discussion on the existence of *one common system goal.*

While Hughes draws attention to the different competencies needed, the process of drawing these components together is basically achievable, even if challenging. In a parallel work, Law (1987b) develops a concept of "heterogeneous engineering" which is more strongly focused than Hughes' concept on conflict and on how different components in networks often are "incompatible." A network's elements almost always diverge – they are bound to diverge and disconnect if left unattended and not encouraged to be associated. Thus, not only the network's context is hostile for its "engineers", but also the elements that comprise the network. While this perspective may seem extreme, and appear to neglect the possibility of harmony and complementary components, it points at the components of a network rather than the network itself. At the same time, the concept of "heterogeneous engineers" shares with "system builders" the idea of the importance of one strong actor's presence to keeping and promoting the system/network based on one common goal.

An II's builders create and retain structure out of heterogeneity by drawing the heterogeneous components together. While this activity can be described as being performed by "system builders", they are themselves heterogeneous and this role shifts between different actors over time. Thus more than one system goal, and different and diverging aims, values and interests, will be involved. Building an II is thus a result of different initiatives from different builders. While making structure out of heterogeneity is one main activity of II building, activities are also related to nurturing heterogeneity, but not just any kind of heterogeneity.

*II building and the role of institutions*

Institutional theory is engaged with institutions as "… the rules of the game in a society or, more formally, are the humanly devised constraints that shape human interaction" (North 1990). Being taken for granted and surviving due to social self-sustaining mechanisms, these formal and informal rules become *institutions* (Avgerou 2002; Jepperson 1991). Institutional analysis, theory and thinking have a long history, applied to study a variety of fields such as macro-sociology, innovation and organisational analysis (DiMaggio and Powell 1991b). While there are several approaches to studying and conceptualising institutions, I primarily draw upon how they have been applied in organisational analysis.

An institutional perspective's significance is the insights it provides in understanding the relationships between processes internal to organisations and its context (Avgerou 2002), which emphasise that IIs develop not only according to technological evolution, but also as products of a social network entrenched in surrounding institutions. Institutional theory helps to explain some of the different influences, which can help to extend our understanding of how IIs change or not.

Builders' approach to II building is not simply according to the existing conceptualisations of evolution, network economics and cultivation. In addition to being linked to the installed base of the various technical infrastructures, the building process is also influenced by a variety of organisations, practices, social networks, organisations, authorities, laws and regulations. This field or cluster of actors is in institutional theory termed as *organisational fields*, i.e. "… those organizations that, in the aggregate, constitute a recognized area of institutional life: key suppliers, resource and product consumers, regulatory agencies, and other organizations that produce similar services or products" (DiMaggio and Powell 1991a, p. 64). Organisational fields create a range of different influences on II building working side-by-side with the legacy of technical components and user practices.

Organisational fields develop through processes of "structuration" or "institutional formation" (DiMaggio and Powell 1991a; Jepperson 1991). A process of homogenisation or isomorphism makes organisations resemble other organisations within the field. This isomorphism does not limit itself to competition for resources, but also extends to political power, institutional legitimacy and social fitness. The isomorphic change occurs

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through three mechanisms: coercive, mimetic and normative (DiMaggio and Powell 1991a). Formal and informal pressures from other organisations, and by cultural expectations, result in coercive change. Not based on coercive authority, mimetic change occurs by organisations voluntarily imitating and modelling themselves on other successful organisations and behaviours. Finally, normative change stems primarily from the professionalisation of occupational practices. Involving a range of different builders, II building involves these processes which shape structures out of heterogeneity.

Institutions represent ways in which human beings structure others' actions based on formal rules and informal constraints (North 1990). Only a small portion of the constraints, which structure human interaction, are formal rules (such as written constitutions, laws and regulations), and a majority of institutions are informal, such as norms of behaviour and conventions. At the same time, formal rules and informal constraints are interwoven, and their difference is one of degree. Formal rules are underlying, and are seldom the immediate source of influence. For example, II builders and building activities are influenced by their individual practices, but also by the relationships between the various builders. These structures and the means by which their formation processes are shaped, can be technical standards, but can also be informal negotiations and agreement on issues such as business models. While formal relations act as means of coordination, personal relationships can play an equally important role.

An institutional focus provides a broader perspective on social structures, which goes beyond the II's constituents. The emphasis is not only on actors and their heterogeneity in the network as humans and non-humans, but also on the institutionalised social practices and relationships. These different components will appear distinctly, but also overlapping, such as technical components carrying with them their builders' conventions (Avgerou 2002). Drawing upon the social context, the emphasis on social institutions' durability also provides a broadened perspective on how building processes are contextualised and how IIs change. This persistence of practices has important implications for understanding how building activities can be pursued, and how evolution unfolds.

With an II building perspective is a need for actors to draw heterogeneous components together. The role of being a "system builder" will, however, not belong only to one central actor, but will rather be distributed between several "system builders", and will

shift over time. Within the organisational field, they will pursue their different values, aims and interests as well as approaches to building. They will be framed in and draw upon heterogeneity's various roles.

### 4.2.2. II and the tension between control and autonomy

The very nature of an II poses challenges for those who pursue control. But control is only one side of this picture – equally important is the autonomy of the involved actors to innovate and further to develop the II. While those who are in a position to delegate control necessarily will be in control over the II's central components, they in turn depend on other actors to be actively involved. I use the concept of control to denote the ability of certain builders to plan and successfully implement changes and thereby to make the II take a trajectory according to their plans. A central argument is, that IIs' existing conceptualisation as not being under central control, should not be taken to imply that partial, even if fragmented and limited, control is impossible. While a critique of control-oriented perspectives is appropriate, we should be cautions not to go too far in the opposite direction and abandon control completely. There will be room for building activities, and the II's very architecture will be an influential factor in determining "pockets of control" in time and space. Control and lack of it also relate to II building in several ways:

- o to local-global tensions as well as local tensions;

- o to both the demand- and supply-sides; and,

- o to the balance between autonomy and control.

I discuss each of these issues below, followed by arguing for a control/autonomy perspective, rather than one based solely on the lack of control.

*Different levels of control*
Control is not only related to the balance between the global and the local as a top-down tension, but control has many dimensions. An II's builders do not necessarily focus only on local-global challenges, but also on the control challenges related to their local practices (Nielsen and Nhampossa 2005). An II's peripheral users in an organisation will, just like central management, experience control adverse situations. Thus, attempts to coordinate various dispersed practices into one common II are not influenced only by the "user-developer" relationships, but may equally well be that of the local practices failing

to integrate the II into their setting (Nielsen and Nhampossa 2005). This perspective also brings forth issues of the "periphery's" possible influence on the II as a whole. While researchers (for example Beniger 1986; Mulgan 1991; Yates 1989) have focused on how technology facilitates managerial control, they also deemphasise how technology may facilitate "peripheral" influences. An II also enables and requires "peripheral" and less significant components (as compared to central components) to have a role in its building activities and developments. While a perspective on control as dispersed between different actors in building activities makes every builder "peripheral" to the II, some are still less "peripheral" than others. For example, the Internet's current shape and development can to a large extent be attributed to Tim Berners-Lee and his personal, small-scale and persistent initiative to develop what is known today as the World Wide Web (WWW) (Tuomi 2002). While the WWW was initially developed as an application that could be used to find phone numbers within the large international research institution CERN, it is today a communication platform of global scale, and is used for a range of different purposes.

*Demand- and supply-side control*
Controlling or not controlling II's demand- and supply-sides are different, but interdependent issues. On the demand-side, how end-users integrate the II into their local context is hard to predict. Users' practices and technology's appropriation serving local needs also diverge, rather than converge, over time (Forster and King 1995). One approach to stimulate an II's growth taking into account user behaviour as out of control, has been described as "bootstrapping", which is a process by which certain actors are conscientiously attracted into a network, which has not yet achieved strong network effects (Hanseth and Aanestad 2003). Initiating growth in demand by playing on network mechanisms, "bootstrapping" focuses on the demand-side and presupposes the ability to control and configure the II to attract users at an early stage.

By not taking the supply-side as one coherent entity, another control dimension appears. On the supply-side, control relates primarily to the technical components' distributed nature, their owners and their engagement in building the II. While complete control is unattainable, control over more central components equips certain actors with more control over others at certain points in time. Negotiation, coordination and cooperation among II builders will over time configure these "pockets of control." Thus network economics cannot fully describe supply-side control, which is also due to negotiations,

alliance building, institutions, power and politics. Issues of controlling an II from this building perspective thus extend to approaches that focus only on demand-side network mechanisms.

*The balance between autonomy and control*

The existing conceptualisation of II points to the challenges of controlling IIs which are distributed in time, space and ownership as well as which exercise strong network effects. But control is not an all-or-nothing proposal. Further, control can be very costly, both in terms of related bureaucracy and administrative tasks, and the fact that control comes with certain responsibilities. Thus building an II is not necessarily done just to gain and secure control under control adverse conditions, and allowing for autonomy by ceding control may be an equally appropriate and important strategy in certain circumstances (Nielsen and Hanseth 2005; Nielsen and Aanestad 2005).

Control and autonomy are inseparable aspects of managing technology (Walsham 1993). Human actors are always autonomous to a certain extent, but their choices will necessarily be restricted by the political context. At the same time, and equally important: "Control must be balanced in a sensible way in order to gain the benefits of the creativity and energy which raises from autonomous activity on the parts of individuals and groups." (Walsham 1993, p. 45). In the case of IIs, builders may allow for and pursue autonomy to serve different strategic aims such as inviting heterogeneity. On one hand, to avoid responsibilities and operational costs, operational control can be delegated. On the other hand, the responsibility for, and possibility of exploring new service concepts and further II development, should be placed with those actors who have the resources, incentives and spirit to engage in such activities. At the same time, control over technology comes with certain responsibilities related to how it is used. When these responsibilities become problematic for those in control, one possible strategy may be to disclaim control over the technology in favour of other actors. Thus, technology becomes to a certain degree "autonomous" by design. A particular case of this approach has been termed as *infrastructuralisation* (Nielsen and Aanestad 2005). Infrastructuralisation can be seen as a process by which operational control is delegated away from a previously centrally integrated and configured network. Through a reconfiguration of the supply-side, certain actors are invited on certain terms to participate in operating and building the previously centrally controlled network. Thus, the technology is actively and purposefully reconfigured to accept the II's nature as not being under control. This

balance is, however, not directed toward controlling II as a *process* – those involved will still pursue control over the overall II and its trajectory.

To understand the building of an II we must focus on how various builders approach the tensions between control and autonomy, and negotiate their roles accordingly. The control structures are reflected in different materials such as standards, business models and institutionalised ways of cooperation. By retaining and delegating control through these structures, some builders at certain points in time have the ability to profoundly influence how the II develops, and as a result, some others are not able to exercise similar levels of control.

### 4.2.3. II as 'standardised packages' and flexibility

Drawing upon Fujimura's concept of 'standardised packages' (Fujimura 1992; Fujimura 1996), I argue in this section that what keeps the II together is not only formal and written technical specifications as outputs of formalised standardisation processes, but also includes a wider "package" of processes and means. Furthermore, the role of standards goes beyond creating interoperability, and how "standardised packages" may limit and encourage flexibility is based on "political" as much as "technical" decisions is emphasised.

Interoperability standards are used by II builders to cater to heterogeneity – to make things work in a heterogeneous context. However, the standards themselves are heterogeneous. In particular, the mechanisms that enable IIs to operate smoothly are not necessarily limited to formal, written and technical specifications. Standards are also represented in different materials, such as technical implementations reflecting their engineers' conventions (Avgerou 2002), practices (Sahay 2003) and business models (Nielsen 2004). The informal and un-written standards are developed not as a result of formalised and bureaucratic standardisation processes, but informally and over time as the II develops. These standardisation processes should not be viewed as haphazard or as not properly anchored to the involved actors. They appear more like projects involving people who need common agreements, and who draw upon existing relationships to negotiate how to keep the II together (Nielsen and Hanseth 2005).

The economic theory of standards does not fully capture the standards linking the various components on the supply-side and their roles. Moving beyond infrastructure as

merely a technical structure calls for re-theorising the concept of standards and standardisation to also include non-technical components and the informal processes by which they come into being. I argue that the notion of "standardised packages" helps to better understand processes of standardising IIs, their standards and their balance with flexibility.

*"Standardised packages"*
In discussing how collective action is managed across organisations to get the work done, Fujimura proposes the concept of a "standardised package." Her example relates to the theory and methods in the development of proto-oncogene research across different biological research sites and clinics (Fujimura 1992; Fujimura 1996). Researchers in different fields of biology adapted the objects and concepts from the "package" to fit their research practices. Over time, varying concepts, materials and practices were adopted in different laboratories. The "package's" nature supported the coordination between the dispersed organisations and the human actors by achieving enough agreement while at the same time allowing local and situated practices to flourish.

Fujimura compares "standardised packages" to the concepts of network building (Latour 1987) and boundary objects (Star and Griesemer 1989). Describing network building as concerning how facts "stabilise", Fujimura characterises boundary objects as coordinating across different worlds, while at the same time allowing ease of reconstruction in the local setting. Thus, boundary objects both support and challenge the "stabilisation" of facts. "Standardisation packages", as argued by Fujimura, are "mechanisms" for handling coordination across different worlds as well as fact "stabilisation". "Standardised packages" are *grey boxes,* combining boundary objects with standardised facts, which are mutually restricting and defining. Thus, "standardised packages" help to narrow the range of actions, but do not entirely define them. "Standardised packages" allow fact stabilisation to a greater degree than "boundary objects".

Standards as "standardised packages" play an important role, and are the central means by which II builders can influence on the other builders, as well as their relationships, by controlling while also allowing for autonomy. While some of these "structures" will be implemented through technical specifications, others will appear more like informal agreements, institutionalised relationships and accepted practices. The shape of these structures will highly influence on the II's flexibility and robustness (Nielsen and Hanseth

2005). While "standardised packages" facilitate integration and support local practices, they may simultaneously play a range of other roles and act as means of building IIs related to:

- o *The politics of openness*: Standards do not indiscriminately and apolitically open up to and integrate any kind of innovations and components. Standards can also lock out. For example, certain actors may take advantage of standards to avoid competition (Shapiro and Varian 1999). Actors protecting their value chain will also support standards which will strengthen their position in the network (Kristoffersen et al. 2005).

- o *Distribution of roles and responsibilities*. Standards can be developed and used as a means for maintaining and strengthening relationships. At the same time, standards can be used as an approach to withdraw from and disclaim certain responsibilities (Nielsen and Aanestad 2005).

- o *Inviting, enabling and supporting innovation.* Flexible standards provide a significant potential for increasing the technical network's size, its market and diversity of services by creating a "commons of innovation" (David 2001; Lessig 2001). In particular, emerging industries gain from allowing the flexibility to explore new (and unknown) services and usages. The way in which standards enable and invite innovation is thus important for the II's growth.

### 4.2.4. *Building as a process of evolution and construction*

The development of IIs is not determined by the autonomy and the evolution of the supply-side alone, but also by II builders' agency. Their different aims, values, interests and approaches are influenced simultaneously by institutionalised practices and relationships between the various builders (formal and informal institutions). I thus argue here that II development and building should be conceptualised as processes of *evolution and construction*, rather than evolution alone.

Evolution of II means that change is not abrupt, but small-scale, incremental and always linked to what already exists in terms of technical components and user practices. Conceptualising II as an evolving process is based on limiting human intervention to nurture and influence the existing II which has its own autonomy. While emphasising inertia's significant role, this perspective lacks precision in describing the nature of II building. Further, it downplays, or rather underplays, the role of the builders' agency. At the same time, the challenges, issues and conflicts that builders have to deal with in their relationships with other builders in building activities, are not adequately addressed.

I argue here that building an II involves both evolution and construction. Change happens conservatively through small steps, but also, in some instances, certain actors can make changes which are more profound than what is possible with cultivation. Rather than autonomously evolving, IIs are strongly influenced and pushed in certain (even if various) directions by their builders. At the same time, institutionalised approaches to II building and cooperation strongly influence human agency.

My concept of II building is framed by a perspective of social shaping (Bijker 1995). To capture the relationship between the social and the technical side of technological development, Bijker (1995) argues that technology is not determined by an autonomous, economic, rational or contingent path or simply based on cognitive problem-solving. Bijker describes technology and the social as an intimately interconnected network of technical, social, political and economic elements. Thus, neither do human actors have complete control, nor is technology completely autonomous. Technological developments, rather, are the outcome of an intricate interplay between these components. A multitude of opportunities influence technologies' development. At the same time, technology influences human action in a multitude of ways. This perspective contributes to the debate on the nature of human agency. This debate is based on concerns about whether technology causes change, or humans determine technology's application. Thus, agency is the capacity to make change (Giddens 1984). Agency has been discussed particularly as it relates to Structuration Theory (Giddens 1984), which conceptualises agency as a human property and that technology has at best an indirect role. The ANT (Callon 1986; Latour 1987; Law 1987a) also discuss agency by describing technical components as actors, and attaches the same explanatory power to non-human and human actors. My perspective is similar to that of Rose et al, an intermediary position: "Humans try to marshal the agency of machines to serve their own purposes, but cannot always anticipate or control the consequences. Outcomes are emergent from the interaction of both forms of agency, not from one alone" (2005, p. 147). Thus, where I argue for a more constructivist account of II building, the aims are to shift the balance toward human agency and to better explain the builders' agency and how its interplay with the II unfolds.

*Extending II's conceptualisations as a process theory: a political perspective*
I have above illustrated some important limitations of the evolutionary perspective. I further argue for a more political perspective in understanding II building. Different

perspectives have been suggested and developed in relation to information systems' design and development, such as perspectives of the *cultural*, emphasising how different cultures influence on information systems' development by their different ways of working (for example Krishna et al. 2004); *symbolism*, questioning information systems' development as economic and rational processes and holding that symbolism is more promising to support our understanding of information systems' development (for example Hirschheim and Newman 2002); and, *conflicts*, emphasising the important role of conflicts in information systems' development as in any organisational setting (for example Barki and Hartwick 2001). While each of these perspectives emphasises different issues influencing on the processes of information systems' development, I have found political issues, and thus the need to apply a political perspective, as more significantly related to II building, as I will subsequently argue.

Focusing on the building activities and their related institutions underscores the need for an account other than evolution alone of how an II develops. I have argued that construction activities in building are as significant as evolution, and the influences exercised by the builders' agency are the outputs of highly political processes of collaboration, competition and coercion (Nielsen 2004). A process theory is an explanation of how and why an entity changes, identifying its generative mechanisms (Van de Ven and Poole 1995). Portraying organisations as pluralistic entities, the intended effects of change and innovation have been said to be curbed by institutionalised practices, particularly those arising from political as well as technical considerations (Keen 1981). Contrasted with more techno-rational approaches, Markus (1983) introduced a sociotechnical and a political variant of an emergent perspective on change. By not acknowledging a dominant source of change, an emergent perspective emphasise organisational change as complex and involving a multifaceted relationship between human actors, organisations and information systems (Markus and Robey 1988). With a sociotechnical explanation, it is the information system's interaction with its organisational context which enables change. With the political variant, change is a result of the interaction between the information system and the distribution of power within the organisational context.

Markus' sociotechnical perspective is reflected in the II's existing conceptualisation. My focus here is on how to also conceptualise a more politically oriented variant where

tensions and conflicts of interests among II builders are in focus. While an institutional perspective focuses on how order and stability are created, a political perspective focusing on conflict stresses "… change, conflict, disintegration, and coercion" (Hirschheim and Klein 1989). Thus, a perspective on change can focus either on the processes that reproduce stability, or on those which create change, and respectively can explain order and equilibrium or change, conflict and coercion. I argue that to conceptualise the building of an II, we need a better grasp of change that transcends both these dimensions.

*Building as a dialectic process of evolution and construction*
With a perspective on evolution, the process of change is conceptualised as slight and successive and as not producing great or sudden transformations. In contrast, *dialectic* theories conceptualise change as the collision of events and contradictory forces competing for domination and control (Van de Ven and Poole 1995). The outcomes of these conflicts are either a new situation that is different from the previous one, the defeat of one actor by the other, or just the *status quo*. While both evolutionary and dialectic theories focuses on multiple entities and their interaction, their modes of change are, respectively, *prescribed* and *constructive*. The evolutionary mode of change works according to a certain direction and primarily as adaptations in a stable and predictable fashion. The dialectic mode of change develops as a struggle with discontinuous, unpredictable and highly uncertain results.

Drawing upon organisational theory, a dialectic perspective helps to bring focus onto different II builders, their various interests and how they create political contradictions within the network. A dialectic perspective conceptualises change processes as being composed of forces that both promote and oppose change (Cule and Robey 2004; Robey et al. 2002). Change is thus a product of the political interplay of opposing forces. This perspective further stresses the significance of building, and of human agency as doing something stronger than only influencing an evolving installed base. At the same time, neither the installed base nor the builders are the sole determinant of change. On one hand there are the contradictions between different II builders, while on the other there are contradictions between builders and the II's evolving installed base.

The interplay between different perspectives on change gives a more comprehensive understanding, because any single theoretical perspective offers only a partial account of

the complex phenomenon (Van de Ven and Poole 1995). While the evolutionary perspective is adequate for explaining an II's stability due to inertia through its focus on human agency's limitations, a dialectic perspective lends itself to a more political understanding of human agency's role, and thus supports a political perspective. I argue for combining these perspectives by conceptualising building as *evolution and construction*. Together they capture both the inertia of the technical components' and institutions' installed base and the agency's significance and the politics of II builders and building. While evolution in a dialectic mode both requires and undermines construction activities, the dialectic relationship between evolution and construction is shaped by political forces.

Analysing building as evolution and construction emphasises the material as it is strongly related to existing technical arrangements. At the same time, different parts of this arrangement belong to different actors because no one is in control of the whole II, but certain actors are in control over certain, sometimes central, components. With a building perspective, lack of control over the II is not necessarily because it is being autonomous, but possibly because certain builders reshuffle control, purposefully or not, in favour of other builders. The challenge is thus not only to take into account end-users' needs, practices and investments, but also to coordinate and negotiate the relationships and interconnections with other builders. Between construction and evolution, an intricate play between different builders emerges, where they draw upon their own as well as others' existing installed base of technical components, social relationships and control structures to pursue their aims, values and interests. They do not pursue only growth, but growth in a certain direction to serve their own agendas. These processes are at the best only partially captured by the existing economic models of networks and concepts of evolution and cultivation.

Combining an evolutionary and construction perspective thus helps to extend II's evolutionary perspective. In particular, it:

o emphasises the issue of *who* builds the II and the nature of the II *building process*, i.e., the institutionalised inter-organisational relationships and processes on the supply-side;

o provides a focus on change and stability as not only determined by competitive survival and population growth, but also due to conflicts and confrontations between opposing actors, aims, values, interests and practices, possibly resulting in discontinuities; and,

o explains stability as not only technical or demand-side inertia, but also formal and informal institutions and active persistence by actors using power to suppress and prevent change.

### 4.3. A synthesis of the theoretical framework of II building

The above discussion and my suggestion for an extended conceptualisation are summarised in Table 5 below.

**Table 5: A summary of the suggested extensions**

| Concept | Extensions towards a framework of II building |
|---|---|
| Heterogeneity | *Different roles of heterogeneity*<br>- Heterogeneity justify the building of II, creates complexity that is reduced by II and required for II growth<br>- Builders, their interrelationships, their roles and their influence on building are also heterogeneous<br>- There are several "system builders" without any common system goal but with different values, aims, interests and approaches to building<br>- Institutions play an important role related to how builders pursue building |
| Control | *Control and autonomy*<br>- Global-local, but also local control of challenges, demand-side, but also supply-side challenges<br>- Not total, but partial control in time and space ("pockets of control")<br>- Controlling, but also delegating control and allowing for autonomy are crucial strategies |
| Standards | *"Standardised packages"*<br>- Standards include a wide range of issues to agree upon to make things work<br>- Standards play the roles of creating flexibility but also curbing change politically; distributing roles and responsibilities; and inviting, enabling and supporting certain heterogeneity and innovations |
| Evolution | *Evolution and construction*<br>- II builders have the agency to make certain changes, but in a political process and influenced by institutions<br>- Evolution and construction as well as institutionalised relationships and structures among its builders shape II development |

The extended II conceptualisation presented above helps to propose an extended II conceptualisation with the following characteristics:

o Heterogeneity illustrates the various roles of heterogeneity and the importance of diversity as well as the structures such as roles;

o control illustrates the diversity of control strategies and the multiple roles of control and autonomy;

o standards as "standardised packages" help to capture the range and variety of standards and standardisation processes, their roles and how they are necessary to make things work; and,

o the process of II building captures change as evolution but also the politics of construction and institutionalised approaches to building and cooperation.

To summarise, II building as evolution and construction is an unfolding process shaped by different forces. On one hand is the existing installed base of human actors and their interrelations such as their ownership of technical components, power structure and institutions. The way in which they engage in II building will be strongly influenced by institutionalised approaches to cooperation and coordination within the organisational field. On the other hand are the possibilities for constructing IIs together with the other actors. Within the field there will necessarily be different, opposing and conflicting aims, values, interests and approaches. While the II's evolutionary character may hamper in a dialectic manner a builder's actions to make the II develop in a certain direction, such attempts can also be actively counteracted by other builders.

The next chapter applies the extended conceptual framework argued for here to the analysis of building the CPA in Norway. In particular, the chapter illustrates the applicability of the extended concepts of heterogeneity, control, standards, and evolution.

## 5. THE BUILDING OF THE CPA AS EVOLUTION AND CONSTRUCTION

This chapter illustrates the applicability of the extended conceptual framework from the previous chapter in the case of the CPA. It discusses the concepts of heterogeneity, control, standards and II building as evolution and construction. The discussion presented here related to the human and non-human actors involved with CPA as well as the relationships between them, is based on my own interpretations and analysis of the data collected.

Content services have been available in the fixed line telecommunication network in Norway since the introduction of Teletorg in 1991. Teletorg was not presented and marketed as an initiative by the existing network operator and according to its profile, but as a commercial interface for third parties where they were free to provide commercial services to end-users. In 1997 both of the Norwegian mobile network operators launched independent platforms for provision of exclusive content and utility-based SMS services to their respective customers. This was a shift from Teletorg in that the network operators now focused on providing exclusive services for differentiation and retention purposes. When the CPA was introduced in 1999 it was in various ways related to these predecessors. On one hand CPA was a continuation, as, for example:

- It was based on the relationships as well as the contractual agreements between network operators and content providers from Teletorg and the SMS-platforms.

- Content providers used their relationship with the media industry from Teletorg for marketing services.

- It was initially based on the technical implementation of the previous SMS-platforms.

On the other hand, CPA was a discontinuation of the previous SMS-platforms, as, for example:

- It was a market wide and "open garden" approach (like Teletorg).

- It gave the content providers the opportunity to charge end-users for more than regular SMS-services (premium charging).

o It gave the content providers the responsibility for service innovation and marketing.

Content services were, until the CPA's introduction, based on the network operators being in control and performing nearly all of the necessary tasks. The CPA divided this vertical integration into functional domains, enabling and requiring a range of new roles and actors. For example, the provision of rather simple services, such as ringtones for mobile phones involves, in the case of CPA:

o music composers (represented by IPR-brokers);

o content providers (choosing and preparing compositions for mobile phones);

o aggregators and application houses collecting a rich variety of content and possibly integrating these into larger service concepts;

o media windows (i.e., newspapers, magazines, TV-broadcasters, etc.) providing space for marketing; and,

o network operators providing transportation and billing services.

When content services for fixed phones were introduced, the formation of this industry and organisational field was initiated. As mentioned, the relationship between network operators and content providers already existed. Other formal and informal institutional influences also have had an effect on the CPA's development:

o Norwegian laws and regulations related to content services for fixed phones;

o informal and later formal guidelines for consumer rights' protection; and,

o the ways of developing and implementing services by network operators and content providers.

More particularly, the approaches to consumer protection have until recently been informal. The common agreement has served the role of avoiding negative attention as well as the introduction of a similar regime to that of Teletorg, where the authorities are monitoring the services and regulating prices.

### 5.1. Building the CPA and heterogeneity

I have argued that heterogeneity has many roles related to II as it serves as an II's justification, it is at least to a certain extent dissolved by an II and it is necessary for an II to grow. At the same time, while II builders are heterogeneous, they also approach

building according to institutionalised ways of building, and some of them have to serve the roles of being "system builders".

The CPA's heterogeneity is reflected, for example, in the CPA platform's different technical implementations by the network operators. While one operator uses the CIMD protocol, which is a subset of Nokia's CIMD2 with additional operator specific parameters, the other operator has implemented a SonicMQ client API toward the content providers. The content providers are thus required to implement a TCP/IP interface, as well as a Java-client, alternatively a C-client. There are several reasons for the network operators not to have implemented one common technical solution, such as, for example, the close relationship between the CPA platforms' technical implementation and proprietary and idiosyncratic billing systems, and the network operators' reluctance to coordinate and even discuss their internal systems. Both interfaces are based on content providers initiating a TCP/IP connection to the respective CPA platforms. Integrators such as aggregators, however, provide interfaces which hide the differences between the operators' implementations of the CPA from the majority of the content providers. This reduces time-to-market and the necessity of substantial up-front investments to connect to the CPA. Further, it also reduces network operators' administrative burden as smaller content providers find it appropriate to connect through the aggregators.

The CPA's building was justified primarily by network operators and content providers uniting to release the potential of their mutual complementarities. It happened because the network operators had large-scale transportation systems, well functioning billing systems and customers, and the content providers had market knowledge and the willingness and guts to risk exploring mobile content services through rapid and risky innovations. Without their diversity of size, strategies, technical infrastructure, user base and history, few incentives would have elicited the creation of a common and market wide II. For various reasons such as CPA's openness as a standard, and content providers' urgent need to create revenues, the CPA's growth continuously unfolded through an increasing network of companies, technical components and service concepts. Thus, building the CPA was based on heterogeneity, as well as enabling and inviting heterogeneity.

At the same time, this does not imply that the CPA is open to everything. More particularly, II builders can implement mechanisms in the II which restrict usages and applications, in particular to preserve or extend their control. In particular, network operators have effectively rejected attempts by other actors than the two network operators to implement alternative CPA platforms in the mobile phone networks. The content providers' limited revenues, as well as the predefined rating classes, also limit which services are possible and viable to provide. Network operators thus promote the II while at the same time pursuing a more local strategy focusing on allowing only certain services and strengthening and preserving their own interests. Building an II thus not only draws upon and promotes heterogeneity, but also shapes it into a certain form.

Another issue is who plays the different roles related to the II and who is best suited for doing so. The network operators' initial role as "system builders" related to the CPA faded away after they standardised their approaches and implemented their technical CPA platforms. Prior to their efforts, as well as currently, content providers, aggregators, and application houses are promoting the platform and putting it into a larger context to enable further developments. In particular, the aggregators are linking various actors such as network operators and TV-broadcasters to create new service concepts. Thus, the tasks of bringing different actors together do not rest primarily with those who own or control the network's central parts such as its technical network or content. This can have several explanations; it could be, for example, because central actors strategically avoid such responsibilities and burdens, or simply because they are more focused on protecting their own assets. These activities and the way they are pursued, also depend on and shape the institutionalised relationships between the involved actors.

The extended concept of heterogeneity points to the CPA as being heterogeneous in various ways. Mechanisms such as standards are not necessarily implemented solely for coordination and interoperability, but also for certain actors to retain their control. At the same time, an II is not only heterogeneous but also consists of some central, even if distributed in time and space, activities of "system building".

### 5.2. *Building the CPA as navigating between autonomy and control*
I have argued that the challenges of control are not only related to global-local relations, but also to the local relationships for II builders. At the same time, control is associated with the demand-side, but, more importantly, the supply-side for II builders. Even if II

building unfolds in a control adverse context, possibilities for partial control still exist. Further, control is equally as important as enabling autonomy in II building, and thus II building should be understood from a control/autonomy perspective.

The network operators are in the CPA's core. On one hand, the CPA has enabled their autonomy by not requiring them to implement a standardised technical solution and interface for content providers. On the other hand, network operators very much control the CPA's trajectory. They may at any time close down services they dislike, and previously they have turned down attempts to develop competing billing platforms in their networks. They may also withdraw and pursue alternative strategies at any time. This autonomy also strengthens the network operators' control over their own networks in a wider sense.

The CPA's network operators were neither able nor willing to be responsible for the services provided. By reconfiguring, or through a process of "infrastructuralisation" (Nielsen and Aanestad 2005), this responsibility was disclaimed by transferring it to the content providers. By actively taking part in an open and market wide standard, the network operators managed to delegate to actors, such as content providers and aggregators, a range of roles such as content production, marketing, service innovation, etc. Thus, the building has also shaped various roles and the relationships among them. The process of "infrastructuralisation" did at the same time unfold as a local and highly contextualised process among the network operators whose management exercised control only to a limited extent, and did not truly have an overview of what CPA was, the consequences of its introduction, and its actual introduction. Even if this was based on the possibility of flexibly steering clear of the prevailing strategies of closed platforms, and the problematic relationship between network operators, the CPA's negotiations and configuration unfolded as a highly delicate process. It involved people and their autonomy on the operational level in the network operators, as well as external actors such as content providers and aggregators. The core of the CPA's building activities has been bottom-up, highly local and based on existing personal relationships and negotiation on a day-to-day basis.

By their change in approach from previous platforms, network operators also are no longer in operational control over the CPA. This is partly because they are not suited to take the roles of being service providers, innovators, etc., and partly because it is more

lucrative for them to cede control and administrative responsibilities. Content providers have been given the autonomy to provide any kind of services, and in practice they hold the CPA's operational control together with aggregators and application houses. At the same time, the content providers' autonomy is restricted by up-front costs which have made them dependent on aggregators, and innovation is thus stifled by limited revenues. Growth is enabled through autonomy, but only in a certain direction and, in particular, to secure the network operators' overall control.

The extended concept of control helps to understand how control remains feasible even if only to a certain degree and only by certain actors at certain times. Control is not always pursued, and equally important is the issue of autonomy. While the II's builders pursue control in some instances, in others they actively delegate control by offering other builders autonomy and the ability to take initiative and control.

### 5.3.    *Building the CPA as a "standardised package"*

I have argued that standards are more than technical specifications and should be conceptualised as the range of issues to agree upon to make things work – as a "standardised package" (Nielsen and Hanseth 2005). This "package" plays multiple roles related to IIs by creating flexibility, stifling change, distributing roles and responsibilities and shaping innovation.

Broadly, the CPA can be described as a "standardised package" containing guidelines for consumer protection, a standardised service level for network operators, standardised short codes and rating classes, coordinated distribution of short codes and a standardised business and revenue sharing model. In this way the CPA was standardised, but also allowed for local practices and implementations from both network operators and content providers. This range of loosely and informally defined standards has created both technical and organisational interoperability between the CPA's various actors – as a "standardised package".

Even if few formal specifications exist, the sum of the formal and informal clearly defines roles and responsibilities related to this basis for a common infrastructure for the provision of mobile content services. While GSM, SMS, TCP/IP, etc. as *de jure* standards developed by formal standardisation organisations play important roles in this infrastructure, the CPA's "standardised package" was largely developed in an *ad hoc*

manner. This approach to standardisation was highly pragmatic, and also turned out to be the only feasible approach under the prevailing circumstances. Without management support, the network operators had neither the resources nor the willingness to engage in more formalised coordination activities, or to develop more extensive technical specifications. Content providers played an important role in influencing and speeding up this process. Based on their experiences with previous content service platforms as well as their ownership of central components, network operators took the opportunity to define them in a highly favourable arrangement. While being favourable to the range of actors involved related to market access, ease of use and innovation, the CPA can be argued as being far from socially optimal. It is also a standard by which network operators harvest the majority of revenues in the mobile content service market without putting significant resources back into further developing the II.

The network operators, in particular, used the extent of standardising interfaces toward content providers as a means to design the landscape of roles and actors. On one hand, introducing a relatively high fixed cost to connect to the CPA encouraged some of the content providers to take on the role of aggregators. On the other hand, to avoid the emergence of one dominating aggregator, the network operators made sure that their technical interfaces for content providers were coordinated in a manner which did not create too high costs to integrate. The "standardised package" thus shaped the CPA's roles and value chain to suit the network operators' needs, which were to avoid the administrative burden of dealing with every content provider and to prevent only one strong aggregator from controlling the content market.

The relationship between the network operators did allow only loose coordination on the operational level. This resulted in a non-technical and informal standard which was suited to both the local practices and the relationship between the actors. At the same time, coordinated short code, rating classes, etc. still maintained the CPA's common idea and approach. Thus the "standardised package" facilitated both a loose technical coupling (internally and between network operators) and a loose organisational coupling. On one hand the CPA allowed for a wide range of innovative services by enabling content providers to freely develop and introduce services as long as they did not breach Norwegian laws. On the other hand, network operators turned down content providers and other actors' attempts to introduce competing solutions. Thus, innovations that put

their value chain at risk are effectively stifled. The "standardised package" thus allows only certain, "peripheral" and ordinary innovations rather than more substantial and radical ones (Kristoffersen et al. 2005).

The extended concept of standards as "standardised packages" paints a broader and more encompassing picture than a perspective of II's built on and coordinated primarily by technical specifications. It also helps to explain the roles of standards as more than enablers of interoperability. In particular, the shape of standards highly influences the organisational field's actors and roles, as well as the possibilities for and the shape of innovations. Further, where lock-in to certain standards has been described as a demand-side challenge for II developers related to diffusion, standards can also be the strategic instrument of certain II builders to lock-in others.

## 5.4.    The process of building the CPA

I have argued that IIs do not simply evolve autonomously out of control, and that II builders have the agency to make certain changes. Through construction activities based on institutionalised approaches to II building, an II is also built as a political activity. Being based on existing relationships, structures and institutions in the organisational field, the building activities also mutually shape these structures.

The CPA's development intricately involves the inertia of existing infrastructures and standards. At the same time, building activities have been influenced by a range of other contextual factors, in particular, the interaction between its builders working side by side with the legacy of technical implementations. The CPA has continuously been challenged by the ways in which network operators usually implement technical platforms. To be assigned resources, new platforms must have a "good" business case, and their development must involve rigid technical systemisation and testing hand in hand with substantial marketing. Fortunately, the network operators managed at the operational level to avoid this regime in the case of the CPA. Together with, and under the pressure of, content providers which acted flexibly, proactively and in an *ad hoc* manner, the network operators managed to develop their part of the CPA.

Network operators, content providers, aggregators, etc. are all engaged in building the CPA. They do so primarily to serve their own strategies and interests and the existing network that they bring along and try to integrate into the CPA. Building the CPA is

considered risky in the sense that it might contribute to a blurring and shifting of the borders between these different actors. At the same time, it provides the opportunity for actors to manoeuvre into other actors' domains, as well as obstructing others from doing so. Where network operators consider the CPA's content services to add value to their network, TV broadcasters likewise find that the CPA's transportation and billing services add value to their TV concepts and network. At the same time, aggregators, integrators and other content providers base their very existence on the CPA. The roles of these different actors and their respective networks are, however, not predefined and static. For example, the content providers are continuously seeking alternative approaches to billing. Aggregators and integrators have also made several attempts to implement competing solutions to the CPA within mobile phone networks. Thus, these actors are trying to take over the network operators' role in billing.

While behaviour from a collectively or a socially optimal perspective is required to a certain extent for CPA, few incentives apparently prohibit actors from acting politically to nurture and strengthen their position. Approaches to building an II should therefore not be understood as *necessarily* good, morally competent and socially optimal. They are also parts of individual strategies infusing politics into the system (Bowker and Star 1999). In particular, the network operators dictate for them a favourable revenue sharing model.

The CPA's building was closely linked to existing institutions, practices, relationships between organisations and technical arrangements. But the process was not just autonomous. For example, the content providers made a difference by bringing the network operators together and convincing them to provide one common platform. At the same time, the final architecture was out of the content providers' hands, but at the same time was based on the strategy and the coordination between the network operators. Over time the process has been evolving, but has also been breaking with previous arrangements and institutions based on different builders' initiative and efforts. While the existing installed bases and institutionalised relationships have influenced this process, certain builders have from time to time been able to make substantial changes, as well as to preserve certain existing arrangements.

The extended concept of II building as construction and evolution, helps to understand the unfolding of II building. In particular, while conceptualising IIs as evolving, it attributes a significant role to human agency in influencing the trajectory of its

development. An II's builders consciously take into account the various facets of heterogeneity, control and standards, and involve themselves in the politics of II building to serve their own values, needs and agendas. Parts of these building activities will be a continuation of previous technical arrangements, relationships between actors and institutions, while other will introduce more abrupt and significant changes. At the same time, II builders' ability to effect change is not equally distributed, and certain actors may actively seek to curb others' agency and certain innovation and change. In this way, evolution in a dialectic mode supports construction activities, but at the same time undermines them.

## 6.   CONTRIBUTIONS AND IMPLICATIONS

This chapter aims to outline the theoretical and practical contributions that arise form this thesis. These contributions are derived from the theoretical analysis presented in this thesis, and from the empirical basis of the CPA case. While the summary of results presented in Chapter 3 focuses primarily on the individual papers' findings, this chapter seeks to synthesise them, and develop broader contributions. These contributions are framed by ongoing debates in IS research broadly, and in II theory more specifically. This chapter has two main sections – the theoretical and practical contributions – each outlining specific areas of implications.

### 6.1.   *Theoretical contributions*

This section discusses three key contributions arising from this thesis. The first two parts describe the contributions of developing an extended perspective on the process of II building, and emphasises both IIs' diversity and specificity. While contributing to II theory, they also provide broader implications for IS research in general as well as IS development. The third contribution concerns understanding scaling issues related to IIs, and while contributing directly to II theory, it also helps to develop a broader perspective on the process of internationalisation in IS research.

#### 6.1.1.   *Toward an extended perspective on the process of building II*

This thesis' central contribution is its development of an extended conceptual framework of II building. It takes as its point of departure an existing II conceptualisation and, more specifically, the concepts of heterogeneity, control, standards and evolution. While these concepts provide a highly useful starting point to understanding IIs, they also have some important limitations. In particular, the multiplicity of II builders and their interrelationships are not emphasised and addressed. The existing conceptual framework portrays II as autonomous and leaves II builders with simply the ability to cultivate, deemphasising the different builders' multiple agencies and the political struggles between them, as well as institutions' and IIs' roles in shaping their agency. Therefore, this thesis has reformulated the concepts of *heterogeneity*, *control*, *standards* and *evolution*. The

implications arising from this framework as a whole, as well as each of the concepts, are discussed below.

To summarise my argument, II's existing conceptualisation should be extended by:

- o focusing not only on II's constituents being heterogeneous and thus challenging, but also by analysing the importance, as well as the multiple types and roles, of heterogeneity, and the importance of "system builders;"

- o focusing not only on II's "capacity of control" characteristic, but also capturing control's multiple roles and the virtues of not controlling, and of autonomy;

- o focusing not only on formal and technical standards, but also on the range and roles of other means of coordination that keep the II together; and,

- o focusing not only on IIs as autonomous and developing according to evolution, but also capturing the process of development as being dialectically of both evolution and construction by being shaped by the II builders through a highly political process within an institutional context.

I argue that the conceptual framework outlined in this thesis provides a different and more nuanced perspective than the existing II conceptualisation. In order to understand IIs' development, the framework must more explicitly analyse the role of those who engage in building them, the influences on their building activities, and the significance and limitations of their actions. In this way, opening the black box of II building, human agency's roles and limitations and their role in change can be better understood. This perspective does not take the view of IIs being sunk, hidden and visible only upon breakdowns (Star and Ruhleder 1996), and explicitly focuses on the activities of those who are involved in their building. In this view, the II is never hidden, but is at the core of the II builders' activities. This conceptual framework provides a different, but also a complementary perspective to that of the existing conceptualisation. Technical inertia, structures of power and institutions all play important roles in II development, and thus they need to be incorporated into our theoretical framework.

This perspective on II building as a political process also shows the lack of control as not only a result of users and their practices being dispersed and heterogeneous and developing according to the economy of networks. For II builders, lack of control can also be a result of the effect of other builders' actions, which in some instances deliberately will seek to make the II take on a more autonomous character to suit their political motives. These political influences are well illustrated through the discussions

that took place at the recent WSIS summit in Tunis regarding how to control ICANN. In particular, the various perspectives and understandings of how best to control the Internet, demonstrated II's autonomy as a highly political matter.

*Heterogeneity and complexity*
Current developments in our society have been described variously in research (Beck 2000; Giddens 1999; Urry 2003) through the concept of globalisation, both as the cause and effect of changes. Through global networks and their interconnections, the very nature of social life, organisations and national societies are changing (Castells 1996). Within a complexity perspective (for example Urry 2003), these networks are not viewed as developing in a structured and linear fashion, but are often emergent, neither well structured nor anarchistic, and leading to a world that is diverse, historical, fractured and uncertain (Urry 2003).

While the CPA is not a global network, and is shaped primarily by local influences, the process by which it was built illustrates how the complexity of heterogeneous networks generates challenges also on the local level. In particular, this thesis has illustrated how building IIs is influenced by the complexity of heterogeneity. What has been pointed out, is that on the local level, heterogeneity is not necessarily a challenge, but can equally be a necessity, creating building opportunities that can be harnessed both strategically and tactically. The increasing complexity in the field of mobile content services has created an environment that is more constructive for facilitating innovation relative to earlier times involving a less heterogeneous setting, in particular due to "walled garden" approaches, and the existence of state controlled monopolies. While the environment the CPA has created involves diverse actors and develops in a highly uncertain and unexpected manner, the network operators still have strong control over, as well as profound roles in, shaping this environment.

Even if heterogeneity's role plays out differently on a global scale, this thesis provides important insights on heterogeneity's varying roles, and how it may be harnessed as a resource. Further, the thesis shows ways in which certain actors may actively (or passively) exercise agency in promoting and shaping heterogeneity and complexity along with the persistence of local control structures.

*II and standards' increasing significance*

Research on standards has until lately been limited largely to the interest of engineers (David 1995). An appreciation of standards' importance has been growing, and is strongly related to globalisation and the increase in information systems' interconnectedness. In particular, the economics of standards (for example David and Greenstein 1990; Farrell and Saloner 1986), their strategic significance (for example Shapiro and Varian 1999), their policy implications (for example Mansell 1995) and their developmental process (for example Mattli 2001) have received increasing attention.

This thesis points out that the raise in complexity and interconnectedness requires not only additional standards, but also different kinds of standards and standardisation processes (Nielsen and Hanseth 2005). Complexity in the sense of uncertainty and diversity requires heterogeneous tools and approaches to enable coordination. Some of these tools will be technical specifications developed by formal standardisation organisations, while others will represent informal agreements emerging from locally situated coordinating processes.

The institutional perspective incorporated in thesis helps to emphasise the role of both these formal rules and informal constraints in shaping standardisation processes. As the world becomes more interconnected, the efforts it takes to make agreements about the shape of standards will increase. If standards are supposed to be the outputs of impartial and politically independent ("due") processes, incorporating the variety of different perspectives and interests present in the arena becomes a major challenge in II building. At the same time, changing universal standards is hard, not only because of the variety of actors and interests involved, but also because universal diffusion complicates the diffusion of new standard "versions". In this situation, the processes of standardisation are likely to be less democratic and voluntary standards emerging from consortia (Hawkins 1999) more prevalent. At the same time, to avoid the risk of universal lock-in effects, interconnections may more appropriately be served by additional means other than technical standards, as "standardised packages". This thesis has argued that IIs based on a "standardised package" that contains only the minimum technical standards can also avoid some of the potentially negative consequences of premature decisions at early stages in their building process, resulting in a more flexible and robust arrangement (Nielsen and Hanseth 2005).

*IIs and the end-to-end argument*

A central debate in IS design is where and how to locate the information systems' "intelligence" (for example Saltzer et al. 1984). A key issue in this debate is the so-called end-to-end argument. Arguing for the location of functions close to those who use the functions, an end-to-end architecture will potentially enable those having the knowledge at the end-points to control how the application grows (Saltzer et al. 1984). At the same time, this architecture will potentially allow for the flexibility, and thus the autonomy, for peripheral actors to innovate, and the underlying and enabling technical network provides only the minimum requirement for establishing these interconnections. David (2005) illustrates this argument through the Internet, in which the intelligence is located in the fringes. Since the Internet is not optimised for any application, but is open and inviting to the unexpected and surprising, innovations can flourish autonomously and without radical changes in standards.

But end-to-end architectures also have weaknesses. For example, the fact that the Internet as an II supports only basic communication services – according to an end-to-end architecture – creates limitations (David 2005). In particular, the lack of more centralised functions to support new transport services for real-time video, etc., as well as the absence of a reliable means to prevent the flow of illegal content such as child pornography and unlawful sharing of music files, are considered by, for example, national authorities and the music industry, as a problem. Different technical solutions have been suggested to overcome these problems. For example, the suggested IPv6 is supposed to provide a "quality of service" oriented approach compared to the Internet's existing "best effort" principle. Another example is content filters implemented by ISPs and end-user organisations which can filter out services and thus thwart copyright infringement (David 2005). At the same time, it has been argued that a growth in these "technical fixes" indicates that the Internet's end-to-end architecture may be nearing its end, and the basic idea of the Internet as an open and free "common" will change (David 2005; Lessig 1999; Lessig 2001). Introducing technical barriers will potentially reduce the Internet's freedom, and thus the creativity of those who aspire to innovate and the related innovations that emerge.

Based on the CPA case I have argued autonomy's importance. At the same time, I have also pointed out the underlying billing systems' important role – without whose support for conducting micro-transactions, the CPA would not have been possible and the

Norwegian mobile content service market would have been different from what exists today. Thus, some forms of centralised "intelligence" in the network are also important for enabling growth and innovation. The revenue sharing between network operators and content providers can be argued as being suboptimal, not appropriate for creating incentives for innovation and resulting from coercive action by network operators. At the same time, however, it has created one of the (if not *the*) most creative and innovative environments for mobile content services in the world. This points to the need for an adequate balance between autonomy and control, and between "intelligence" outside and inside the network to support innovation. What has been challenging about the CPA is the network operators' relative autonomy to decide and shape this balance and, as a consequence, the distribution of costs and benefits, and also the business sector's roles and "architecture". Within a broader institutional perspective, the network operators can also be seen as harnessing their key position in the organisational field and drawing upon formal rules as well as informal constraints. At the same time, the institutional context is shaping their capacity to do so.

To summarise, the II building perspective proposed here, contributes to a perspective where not only the IIs are out of control, but also the II builders and their building activities. This perspective shows how complexity as heterogeneity plays out on the local level, and how such complexities require coordination, which is better understood as "standardised packages" than as technically and formally specified standards alone. At the same time, it is pointed out here that a dispersed and heterogeneous network still requires certain central services and activities to facilitate further developments and innovation.

### 6.1.2. *The diversity and specificity IIs*

The extended perspective this thesis suggests, helps us better to understand business sector IIs, but the unpacking and extension of the different concepts also raise questions which are relevant across different types of IIs. In these questions, and their answers, lie opportunities to understand the similarities and differences between different types of IIs, as well as the context of specific and independent parts of the II building perspective. Hanseth and Lyytinen (2004) suggest an analytical distinction between different types of "vertical" IIs according to their scale and scope: universal (like the Internet), business sector (like EDI networks or the CPA) and corporate (like corporate-wide SAP or ERP systems). A scale and scope focus is, however, limited to illustrating quantitative

differences between IIs, i.e., universal IIs are larger than corporate IIs, while deemphasising qualitative differences between IIs for different domains.

The aim here is to draw implications broadly to II research as well as to show the limitations of proposing the conceptual framework as one which can be universally applied. The discussion here centres on the range of balances involved in II building, between heterogeneity and structure, control and autonomy, standards and flexibility, and evolution and construction.

*Heterogeneity and structure*
This thesis has pointed out heterogeneity's various roles as well as the "system builders" importance. Heterogeneity is an important justification for developing IIs, and serves as an important component of the complexity IIs seek to resolve. I argue that heterogeneity also applies in the case of corporate and universal IIs although its nature may be different from business sector IIs. At the same time, heterogeneity's necessity for II growth is not so obvious in corporate IIs, where the common focus is to standardise across the different parts of a corporation, and to make information more available to management (for example Rolland and Monteiro 2002). Therefore the aim of such IIs is not primarily to encourage new and different local practices and extensions to the II, but on the contrary, to control and eliminate them.

The importance of various "system builders" engaged in developing and promoting the II applies similarly to universal IIs and less so for corporate IIs. Whereas the business sector and universal IIs are joint ventures of a range of different actors and lack obvious centres of activities, building activities related to corporate II will be performed primarily by the IT department in collaboration with the end-users, when that is seen as appropriate from a central perspective. Ciborra illustrates this by showing how the management of a big pharmaceutical company relinquished control and standardisation over its Intranet as "a mixture of releasement and cultivation" (Ciborra 2000b, p. 211). End-users taking their own initiatives and continuing their peripheral practices may thus be interpreted from a managerial perspective as damaging attempts at standardisation, but may also be viewed as supporting the II's diffusion. These different strategies and the associated debates on management and building activities will at the same time unfold on the "user-developer" axis.

The extended concept of heterogeneity helps to question its role as well as the "system builders'" role, responsibilities and significance. Corporate IIs differ from business sector and universal IIs by being less dependent on heterogeneity for their growth and by how "system building" is primarily a centralised activity on the "user-developer" axis.

*Control and autonomy*
This thesis has emphasised human agency's role in controlling II developments' trajectory, as well as in the importance of II builders' autonomy. The size, location and frequency of the "pockets of control" will be related to the II's size. Like business sector IIs, building universal IIs as globally dispersed networks will be challenged by the lack of centralised control, because building activities are dispersed. While corporate IIs may be challenged by the need to deal with scattered users and their local practices and initiatives, control becomes not primarily an issue of II building, but of how the IIs are locally appropriated and used. Even if corporate IIs do not depend on heterogeneity, this does not imply that their autonomy is insignificant, as the degree of autonomy is essential for local practices. Universal IIs are required to enable autonomy to grow, in the same way as business sector IIs. Further, the universal reach of universal IIs will attract added attention from governments, media and people in general, so additional significance will be attributed to issues of autonomy and control such as pointed out here in the case of the Internet.

The extended concept of control balanced with autonomy helps the analysis by questioning where control is situated and how and to what degree autonomy must be allowed. Regarding corporate IIs, this is an issue between centralised building activities and end-users, while the building of universal IIs unfolds under control-adverse situations where enabling autonomy is crucial, but may also be controversial.

*Standards and flexibility*
This thesis has argued that II standards are best understood through the concept of "standardised packages", which helps to emphasise standards' different components and roles both to create flexibility and to curb change. This logic applies also to corporate IIs where standardisation across a corporation may be best served by means other than formally specified technical standards alone. In the case of universal IIs, however, their sheer size and ubiquity may make the role of formally specified and technical standards more important. In particular, the negotiation and coordination required to develop

informal agreements and practices become more difficult as the number of and distance between the involved actors increases. The extended concept of standards adds to the discussion by pointing out the limitations of formally specified and technical standards. It suggests the need to balance the approach and understanding of standards and standardisation by including negotiation about practices and coordination – as "standardised packages" that vary across different types of IIs.

*Evolution and construction*
This thesis has pointed out how II development should be conceptualised as a process of evolution and construction, influenced by politics, institutions and the legacy of existing IIs. Such a perspective helps us to understand the development and building of both corporate and universal IIs. At the same time, the institutional and political arenas are likely to differ. In the case of corporate IIs, power structures are likely to be less ambiguous because the corporate arena is more narrow and structured than, for example, a business sector. As pointed out above, II building is a centralised activity, and its control is primarily challenged by the relative autonomy of user practices. In the case of universal IIs, the arena is likely to be wider and the structures more ambiguous than that of business sector IIs. Power belongs to a variety of different II builders, while their building activities are shaped by different institutional influences. The extended concept of evolution, picturing II development as evolution and construction, helps to question the role of institutions, politics and technical components in shaping the building of IIs.

I have argued how the different conceptual extensions suggested in this thesis help to raise a wide range of questions relevant across many different types of IIs. By doing so, I also have illustrated variations between different types of IIs. Thus, the building perspective suggested here points to qualitative differences between IIs, and how their elements are both context specific and independent. Without specifying clear distinctions between context-specific or context-dependent elements, I argue that the difference between IIs is one of degree. The concepts that this thesis illustrates may apply less to corporate IIs than to universal IIs, because corporations are more structured, limited and closed in nature than business sectors and universal IIs. At the same time, I argue that the general principles of heterogeneity, control, standards and the process of building can, however, serve as appropriate lenses to examine different IIs empirically.

### 6.1.3.    The issue of scaling in II building

Another important debate related to IIs concerns the issue of scale and how IIs can be scaled up. The II can be expanded in size and scope within its existing context (by, for example, adding functionality or users) and/or integrated into a different setting (by, for example, "transferring" it to another country) (Sahay and Walsham 2005). Scale can be defined as an II's scope, while scaling refers to the process of expanding the II in scope and size. Scaling is not only about numbers and size, but involves IIs' totality as heterogeneous networks and involves builders and their installed base of IIs, practices and institutions. Thus, scaling an II will necessarily require drawing upon and being shaped by what already exists, which at the same time is influenced by scaling processes. This thesis contributes to the understanding of scaling processes, in particular, by emphasising II builders, the role of their agency and their institutional context.

The concept of scaling has been discussed in IS research only to a limited extent, and prior research has been limited primarily to drawing insights from experiences with the Internet (e.g. Monteiro 1998). In his discussion of the revision and change of the internet protocol (IP), Monteiro illustrates scaling challenges arising when an II's expansion exceeds some given limits and it must evolve to further expand. Due to the existing II's complexity and conservative forces, it is assumed that scaling must follow a transition strategy with small and incremental steps, also described as cultivation (see for example Hanseth and Aanestad 2003). This discussion is at the same time related primarily to the technical architecture of IIs and diffusion, deemphasising scaling's more social aspects.

From the perspective of understanding globalisation processes, the issue of scaling is also relevant (Sahay and Walsham 2005). Perspectives based on globalisation as homogenisation assume the possibility of scaling, while the opposing perspectives of heterogeneity point to it being inherently problematic. Alternatively, a middle ground position can be taken by arguing for a "pragmatic balance" by carefully scaling what is context independent, while leaving flexibility for the context dependent components (Nielsen and Nhampossa 2005; Rolland and Monteiro 2002). The perspective on IIs presented in this thesis helps by unpacking the balance between top-down and cultivation approaches and the "all or nothing challenges" of scaling (Sahay and Walsham 2005), and by focusing on building activities goes one step further by also discussing how to attain them.

*Scaling IIs and evolution*

Suggestions to address the challenge of scaling IIs with transition strategies and through small-scale changes can be understood both as being pragmatic as well as expressing human agency's capacities and limitations. On one hand, understanding IIs as being built on fragile arrangements and practices, using the cultivation metaphor, helps to illustrate the need to be careful not to make changes and introduce technology which may undermine and destroy what already exists (Bergqvist and Dahlberg 1999; Dahlbom and Mathiassen 1993). On the other hand, transition strategies can be conceptualised as the only possible way to support scaling because of IIs' heterogeneous and dispersed nature, the associated lack of control (Ciborra 2000a) and human agency's limitations.

The perspective on II building provided in this thesis extends an understanding of scaling IIs as evolution. In particular, focusing on II builders emphasises the politics of II building and the builders' nature and role. In doing so, my perspective focuses on the role of human agency and how certain II builders may at certain times make substantial changes to the II. Thus, scaling can also be pursued through more drastic approaches than only small-scale transitions. For example, related to CPA, different actors and the organisational field in general have influenced the scaling of proprietary mobile content service platforms into a market-wide and public II. Network operators took the opportunity to define what was for them a highly favourable II in terms of costs and benefits, based on their central position in the organisational field. This change in approach, as well as the CPA's further development, was at the same time initiated, driven and facilitated by content providers, aggregators, etc., based on their eagerness and ability to innovate as well as to create a "neutral ground" for coordination.

*The "all or nothing" challenge in scaling IIs*

Sahay and Walsham (2005) point out the challenge in scaling that IIs may be perceived as useless by potential users if sufficient data are not available. Hanseth and Aanestad (2003) take a similar perspective and further propose "bootstrapping" as a strategy to accommodate the lack of value in a network empty of users, usages and information. This thesis emphasises that the "all or nothing" challenge is related not only to information, usage and users, but also to II builders and the institutional context within which they operate. Scaling not only requires some builders to take some centralised initiatives to scale the II, it also requires builders in new contexts to engage in II building and others to work across different contexts. What is apparent in the case of the CPA is

that the organisational field of mobile content services differs from country to country, in particular as it relates to the presence of various II builders and their eagerness to take initiatives.

Network operators and content providers have attempted to make mobile content services into a more universal market than currently exists. In particular, one of the Norwegian network operators has tried to implement CPA platforms in its internationally dispersed affiliates (Denmark, Hungary, Ukraine, Russia, Malaysia, Thailand, Bangladesh, etc.). At the same time, various content providers have tried to provide services across various national markets. These attempts have shown varying and, in general, limited levels of success across different countries. The content's nature is to a large extent international (ringtones, logos, wallpapers, etc.), but its success depends at the same time on the presence of a CPA-like platform in the new markets, and equally on the possibilities of content providers to team up with media-windows in order to market their services. Thus, scaling depends on the technical infrastructure as well as on the organisational field. The lack of success in scaling the CPA can be attributed to the relatively recent introduction of mobile content services in general, and to the notorious delays in the next generation of mobile telephony (3G), which indeed have impeded growth in the demand for content services. But I argue that it is also apt to question whether the CPA and other approaches really are scalable solutions, which parts of the CPA can actually be scaled, and how. Scaling is intrinsically challenging, as a result of both the variety of technical platforms' installed bases across varying countries as well as their different institutional contexts. With this in mind, scaling the CPA depends on a range of actors taking up the same idea and pursuing similar strategies by engaging in common building activities. In countries whose organisational field differs from Norway's, in combination with an institutionalised reluctance among network operators to cooperate, scaling will be problematic. At the same time, scaling can also be pursued by content providers who can create a "neutral ground" for coordination between the various actors.

Perspectives on technology transfer have limitations that suggest us carefully to evaluate what aspects can and should be scaled, and what should be left open to local customisation (Nielsen and Nhampossa 2005). Universal solutions must be adapted to the local contexts where they are implemented, and influenced by the existing installed

base of technical components as well as the institutional context. This process of translation and the "costs" it generates will depend on the need for universal standards, the II's flexibility and the local institutional context. The proposed perspective on II building goes one step further in this discussion by focusing on what can be scaled and who engages in scaling, emphasising the range of actors involved in the building activities, their roles and how they contribute to developing, shaping and scaling the II. This perspective can offer useful and extended insights into the scaling of IIs nationally as well as across international contexts.

### 6.2.    *Practical implications for the building of mobile content services*

Even if Norway's CPA is limited in size and in its influences on the telecommunication, computer and content industries in general, its development has involved actors who will also play a role in the future development of mobile content services. The case study more particularly has offered the following insights:

o The CPA's building was situated and influenced by a range of contextual factors. In particular, existing strategies, practices and experiences with mobile content services, institutions and institutionalised ways of building IIs and cooperation, technical arrangements and ownership, and power structures played important roles. The different human actors involved in the building process were influenced by, drew upon, challenged and strengthened these resources and structures in a variety of ways.

o The building process unfolded without a clear "master plan", but neither did it unfold without plans. Rather, the multiple plans of the actors involved in building somehow "converged" over time into a common idea of an II and joint building activities.

o The building process' primary output was not a technical and formally specified standard or one common and standardised technical platform. Rather, it was a package consisting primarily of informally defined and loosely specified agreements offering what was necessary to make things work as well as providing the flexibility the involved actors required.

In drawing implications for the building of mobile content services, without presuming to describe guidelines or "best practices", I seek to emphasise that building IIs is a highly situated and contextualised process, with no one "superior" or best approach. This does not, however, encourage a "free for all" approach. What should prove to be a useful insight from this thesis is its suggestion that a variety of human actors involved in II building need to direct their attention and to strengthen their knowledge about the community of II builders, the various roles played, the institutional setting and the wider

context and implications of building activities. The specificity of different national contexts will require different approaches, but II builders will always have to manoeuvre to respond to varying contextual influences and to the politics of building activities.

*Understanding the role-play of II building*
My narrative of the CPA's building is not a "success story", but emphasises the network operators' crucial role, at least of a few of their employees, in allowing external content providers to provide content services over a market-wide platform. At the same time, the network operators' effort and contributions more or less ended with that. Since the platform became open to external actors, it is the content providers, aggregators, application houses, etc., who have pursued its further development and growth.

My perspective has drawn attention to an II's contextual nature and to how it extends, changes and restrains the existing socio-technical networks. For mobile content services, the networks are composed of components from a variety of different industries such as the telecommunication, computer and content industries, involving a range of different builders and their idiosyncratic understandings of how the II should be developed. The II's builders are focused on serving their own interests, which may damage socially optimal solutions. It is thus vital for actors engaged in developing the II to recognise the politics it involves, and the importance and intricacies of coordinating across organisational borders and the business sector. The bits and pieces needed to build a complete and thriving II require a common recognition of the range of different roles to be played, and also the distribution, and its consequences, of roles, risks, burdens and benefits.

*Appreciating the role of standards as a means of coordination*
Taking into account the wide range of actors and interests involved with mobile content services, it becomes crucially important to facilitate smooth coordination and interoperability between II builders. We should, however, be careful when attributing importance only to technical and formally specified standards. In particular, more informal and non-technical standards may provide far better support under rapidly changing circumstances, as well as allowing for diverging local practices. Thus, to be involved in II building for mobile content services also means to draw upon, participate in and facilitate distributed, informal and contextualised coordination activities. Building

these collaborative environments and networks as well as drawing upon their outputs is of crucial importance.

While realising the role of flexible and informal standards as a means of coordination, we must at the same time understand how standards promote varying political agendas. Standards are not necessarily neutral, but significantly influence the II's very shape, the actors and roles involved, and how innovation is facilitated but also curbed. While incumbents will use standards to maintain existing structures, "insurgents" can, on the contrary, use them to rupture the very same structures. And as illustrated in the CPA case, most actors acted both as "insurgents" and incumbents at the same time. Who wins these battles over time will be decided by existing technical and institutional structures, the coalitions of actors, and the power asymmetries. The II's builders must find their own opportunities in these processes, and actively avoid getting trapped by unfavourable standards and structures.

*The politics of openness and growth over exclusiveness and retention*
Changing previously controlled and independent networks to make them become only a part of an II, can be perceived as risky. Losing control and giving up the potential of providing exclusive services for differentiation purposes and retention is a problematic decision to make. I do argue, however, that a closed and exclusive as compared to an open and public approach, as in the case of mobile content services, is subject to some essential limitations (Nielsen and Hanseth 2005). In the case of Norway, some more or less obvious short term and economic arguments support an "open garden" approach, due to Norway's small market, the weak ties between its content industry and network operators, and the lack of importance network operators attribute to mobile content services. More essential, the provision of exclusive services implies editorial responsibilities, and the need for tighter control by network operators. The history of content services in Norway has shown that network operators are particularly unfit to grasp which services the market will accept, and the Japanese i-mode approach has shown the downside of a slow and black boxed bureaucracy for service approval. If only services with a good business case were approved for the CPA, there would have been no services (or different services), because network operators did not believe in such services in the first place. Another crucial question which should be asked, is whether we would like to see the "mobile Internet" as open as the traditional Internet we currently know, as closed as i-mode's "mobile Internet", or something in between. As illustrated in

the discussions in Tunis, different people have different views on this issue. In particular, targeting anything other than an open model for content service raises the questions of whom should be granted control, and the editorial responsibilities for content.

Even if the CPA is open, it is not entirely so. Basically, the network operators have managed to monopolise the billing of mobile content services through a scalable and cost-effective billing system. On one hand the network operators' billing system can be argued as enabling a market for content services. On the other, network operators keep their key position and effectively reject attempts to break up their value chain. A prominent and problematic consequence of this position of the network operators has been their definition of what is perceived by the majority of the other actors involved as an unfair revenue sharing model. Content providers will always seek to increase their share of revenues, but the arguments behind the network operators' revenue sharing model have not been clearly communicated in the content service market. And even if arguments about the network operators spending on building and maintaining the relationship with mobile phone users justify a significant share of revenues, the network operators' activities are perceived as not geared toward the CPA market's growth. The activities of those who pursue growth – the content providers, aggregators, application houses, etc. – are being curbed by resource limitations. This underscores the need for extensive knowledge of how IIs may influence innovation.

Table 6 below summarises the practical implications as key insights and actions for those involved in building IIs for mobile content services.

Table 6: Implications related to building IIs for mobile content services

| |
|---|
| Carefully analyse the different institutions, actors and roles involved in mobile content service provisioning, and create a common understanding of this organisational field. |
| Carefully analyse the role and appropriateness of different standards, and avoid getting trapped in the politics they inscribe. Build collaborative environments to facilitate coordination. |
| Carefully analyse the risks, burdens and benefits before choosing between centralised and controlled, and public and open approaches to mobile content service provisioning. Provide centralised activities to support innovation and distribute burdens and benefits in a way that favours innovation. |

Even if the CPA has been endowed with limited significance and financial resources, it has involved a highly complex and intricate building process. When the huge investments in the next generation of mobile telephony (3G) are supposed to be recouped by services

such as mobile content, the politics and complexity involved are likely to become even more pronounced than in the case of the CPA. In the next chapter, I briefly discuss further developments in this area as well as point out how further research can extend, as well as be supported by, the insights provided in this thesis.

## 7.  CONCLUDING REMARKS AND FUTURE RESEARCH DIRECTIONS

Previously stand-alone information systems are increasingly being interconnected in various corporate, industry-wide and global networks. As a continuation of the history of information technology's steady increase in flexibility, reach and range (Keen 1991), contemporary changes are, however, not only the effects of improvements in computing power, bandwidth and software capabilities. As information systems become increasingly connected with and dependent upon one another, so also do people and their practices, organisations and institutions. Ubiquitous, heterogeneous and pervasive technical networks develop hand in hand with the battle over controlling them. While more general technical capabilities have been shown to be scalable, IIs' constituents and complexity are not necessarily so, and thus require new and different approaches. Their scaling is not carried out in the laboratories and factories of the telecommunications and computer industries, but unfolds as an activity as ubiquitous, distributed and fragmented as the IIs themselves.

Mobile content services are a part of these developments. With the pressing need to recoup investments in network licences and infrastructure, mobile content services are supposed to play a crucial role for the next generation of mobile telephony (3G). While value added services in telecommunication networks are nothing new (see for example Mansell 1988; Stoetzer 1992), the significance attributed to mobile content services is becoming more pronounced, as illustrated by the words of the European Commissioner for Competitive Policy:

> *"It is clear, however, that although electronic communication networks have tremendous potential there is still a gap between this potential and the growth in demand for new products that we see in reality. The speed with which the industry will fill this gap will depend on the drivers of growth. In particular, availability of content is likely to lead to new electronic communication networks like 3G mobile and broadband internet developing into new media delivery platforms, which in turn will spur the development of the networks themselves."*[13]

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[13] Speech given by Mario Monti, Brussels, 8 July 2004, for the Workshop on Access to Quality Audiovisual Contents and Development of New Media.

These words of the Commissioner also highlight an important issue related to ongoing II development. As mobile content services are attributed more relevance, they also become more complex. The attention given by the Commissioners will perhaps channel more resources, actors, policy makers and business sectors into this industry. However, the 3G stalemate (discussed by for example Jansen and Nielsen 2005), well illustrated by the Commissioner arguing for content to be the driver for networks, and the counter arguments that networks will drive the content, will not necessarily be more easily resolved by involving more people, resources and attention. On the contrary, they may curtail developments due to the increasing political nature of the building process they create. This argument should not be taken to refute the possibility of developing successful and thriving 3G networks with an array of new content services. It rather provides a perspective which suggests that we should acknowledge the complex and political nature of building IIs. The conceptual framework of II building presented in this thesis should help us better to understand these processes.

The theoretical framework of II building illustrates certain kinds of complexities, and tries to unpack how II builders are dealing with them. In particular, these complexities are related to the increasing number of, and difference between, the builders involved in the building processes, their institutional context, and their political agendas. The challenges of II building relate to dealing with this complexity. One general strategy to deal with complexity is to eliminate it or to control and "black box" it by means such as gateways. In this thesis I have illustrated how different structural means have been used to curb, but also enable and actively invite, new roles and actors, and thus complexity. At the same time, the ability to control complexity rests with the few – and with limited "pockets of control" in time and space. Thus, the II builders are chiefly left to live with the mess and complexity (Aanestad et al. 2005) – a complexity which is challenging but at the same time is required for further growth. In this context, we should be careful not to see the applications of *ad hoc* strategies of standardisation and coordination to make things work as haphazard and not properly anchored related to the involved actors, in particular because this from time to time will be the only alternative. And perhaps more important, such approaches are not necessarily temporary, but can be permanent arrangements to cope with and build an increasingly complex world.

Earlier research examined take-off challenges in II development, and suggested "bootstrapping" approaches to make them grow from scratch (Hanseth and Aanestad 2003). At the same time, "lock-ins" due, for example, to the diffusion of standards have been identified as a challenge with more mature IIs, which can be avoided upfront by flexible standards or dealt with by gateways (Hanseth 2001). This thesis has focused on and conceptualised the building of IIs and the challenges confronting it without a start or an end. In particular, from the institutional perspective, IIs will always be built on and into existing social structures, and will continue to exist, even if changing. Where the CPA as such may disappear within a few years or months, its relation to and changes of the regulatory environment in Norway, its organisational field, the structures of power and the approaches to building IIs are likely to live on. With this perspective, building processes are learning, but also, at least for some, de-learning, and building new institutions also requires de-institutionalisation. Old technical arrangements and practices live on, and sometimes they must be changed to allow for new and different approaches.

The theoretical perspective of II building has been developed based on a relatively limited empirical study of a somewhat small II. While the insights provided are valuable related to other types of IIs (corporate and universal), this thesis also has its limitations. While some of these limitations and related suggestions on how to approach them are outlined below, empirical research across different scales and domains is required to refine the perspective of II building presented in this thesis.

The focus on the process of building IIs in this thesis inevitably implies that other issues are downplayed and left out. In particular, three research directions should appear pertinent in further research on II building as well as on mobile content services. First, the empirical research has developed insights into the various II builders' diversity of values, aims, interests and strategies. At the same time, how these perspectives come into being and develop over time, how they are internalised and communicated, and how coordination and negotiation among various II builders unfold on a day-to-day basis have not been studied in-depth. To better understand these processes, future research would gain from changing its focus from following the building process to more specifically following some of the II builders more extensively than past research in time and space based on ethnographic approaches (for example Suchman et al. 1999).

Second, this thesis has discussed the fragmentation of control in II building's distributed and dispersed processes as resulting in "pockets of control". While IIs are evolving, certain II builders have the power to make certain changes to the II at certain points in time and space. Still more research is needed into understanding how these "pockets" are similar to and different from other control structures. A better understanding of how the structure, or perhaps network or fluid, of these "pockets" operates, changes and shifts over time has the potential to improve our understanding of both IIs and II building.

Third, the empirical research and the conceptual framework of II building are not focused on the end-users. On one hand, the perspective of II building presented here sees end-users as one factor among a range of others. On the other hand, mobile content services until now have been primarily consumer goods, creating user habits and needs by promoting and supporting entertainment and leisure, rather than serving important organisational needs. When the "quality" of services is related to current hypes and trends, which are coming and going, creating increase in demand does not necessarily require new and innovative services, but more extensive marketing. Creating substantial uncertainty about future development related to what the market will "accept", users are in this area largely invisible and without the legitimacy to participate in the building process. To better understand the character of and potential in mobile content services requires more focused research on the nature of end-user population and on the nature of the end-users' needs. Studying users' needs across age, gender and nationality will involve perspectives such as culture and diffusion of innovation. Research should also carefully investigate why the portfolio of content services is primarily limited to entertainment and, perhaps more important, seek solutions to how to facilitate the development of a broader spectrum of services.

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APPENDIXES

APPENDIX I


Petter Nielsen

Implementing Public Platforms for Mobile Phone Content Services: Standardization in an Era of Convergence.

# IMPLEMENTING PUBLIC PLATFORMS FOR MOBILE PHONE CONTENT SERVICES: STANDARDIZATION IN AN ERA OF CONVERGENCE

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## Abstract

*Mobile Telecommunication standardization in Europe builds on a history formed by European and International standardization bodies, the governments as regulators and the R&D departments of PPT-owned telecommunication operators. This paper describes the standardization approach related to the implementation of the public CPA (Content Provider Access) platform and business model for provision of content services for mobile phones in Norway. CPA builds on complementary services and common incentives for mobile telecommunication operators and content providers to create an open, transparent and easy to access service platform through standardization, but is at the same time developed outside both the scope and the central control of standardization organizations and their standardization practices. The nature of this process can be attributed to processes of convergence. Applying an Information Infrastructure perspective, we discuss the standardization process as open, where the trajectory of development is determined by heterogeneous actors with different and possibly conflicting agendas, powers, needs and incentives. Our aims are both to identify and describe new approaches to standardization as well as new kinds of standards within telecommunications.*

*Keywords: content services, CPA, convergence, standardization, mobile telecommunication, fragmentation*

## 1    INTRODUCTION

Long withstanding predictions and processes of convergence between information- and communication-technologies envision a future environment of new mobile devices, services, business opportunities and usages (for example Branscomb and Keller 1996; Kakihara et al. 2002; Mansell 1988). European governments' policies and action plans are also placing strong emphasis on the convergence of information and communication technologies in their efforts in constructing and developing a new and competitive "*e*Europe" (e.g. COM 2002). However, *convergence* does not come by itself or is driven solely by technological breakthroughs or the political and centralized will or actions of governments. Convergence is a process bringing together different and heterogeneous actors as well as markets and technologies, a process not only bringing synergies but also challenges. The power of deciding (pushing in various directions) the trajectory of convergence is dispersed among heterogeneous actors with different and possibly conflicting interests, powers and agendas. The conflict of interests are also augmented as the future landscape of actors and their assets, responsibilities, relations as well as the boundaries between them is open and unknown. Even if convergence is technically achievable and appropriate, key actors are still likely to keep and defend their assets and market positions. One arena where these processes are unfolding is the one of standardization.

Technical standardization plays a crucial role in the development of innovations within the mobile telecommunication sector, as for example NMT and GSM in the Nordic and European context. These standards did however emerge in a certain context, in particular facilitated by international cooperation between the R&D departments of PTT-owned telecommunication operators (Godoe 2000). Through standardizing organizations, researchers representing national European telecommunication operators

and the industry have discussed and harmonized technological platforms that did not previously exist. Largely, these actors were homogenous in preferences, interests, and priorities and thus were well prepared for consensus making. The standardization of CPA on both the business model and platform level unfolds outside the scope of existing telecommunication standardization institutions, but also their control. This can be attributed to the many levels of openness that signifies convergence processes. For example, the actors now engaging in negotiations and coordination are either unknown to each others, or in fierce competition. The nature of convergence is also magnifying the conflict of interests between the Mobile Telecommunication Operators (MTOs) and the content providers as the borders between their businesses and assets are blurring and possibly shifting.

Telecommunication markets are today increasingly liberalized. Sector specific regulation has been replaced by ex-post anti-trust legislation and the monopoly of the PPT-owned operators is deregulated. One side effect of these processes is that the R&D departments of telecommunication operators have lost their cooperative ties, not only because they are in fierce competition (nationally and internationally), but also because of the fear of anti-trust legislation. The process of convergence is at the same time resulting in the deterioration of the ability and power of telecommunication operators to control standardization and innovation alone. Even if their control have been challenged through history by national governments in particular related to telecommunication policies (discussed by e.g. Haug 2002; Manninen 2002), convergence through the development of the CPA standard is currently bringing to the field a range of new actors, in particular relatively small and heterogeneous content providers.

MTOs give content providers access to transport and billing services (premium charged SMS) through the implementation of CPA platforms. This enables the provision of content services to subscribers with a feasible business model for billing the content. The CPA standard has evolved in Norway through small-scale efforts within and between different MTOs, in tight cooperation with entrepreneur spirited content providers. CPA provides a business with a total annual turnover of 600 million NOK (€ 75 million) in 2003, a substantial growth from 400 million in 2002. The services are typically ringtones, logos, jokes and simple information services such as stock quotes, phone directories and weather forecasts. In addition, interactive-TV enabled SMS as a return channel is a growing business, counting for 15 percent of the turnover.

The standardization of CPA has unfolded outside the scope and the control of the telecommunication standardization regime, and therefore requires new and different institutions for coordination. CPA is not a result of technical standardization prior to the implementation of the CPA-platforms. It is built on the coordination among the MTOs and an evolutionary technical implementation as the market and the nature of the services become apparent and further develops. Within this environment, MTOs have the power to influence the development of the standard, but the power is unevenly distributed among them as well as shared with the content providers. As the standardization process is made open by convergence, these actors together face the paradox of conflicting interests while at the same time having a common and strong need for cooperation and standard making.

One fruitful approach to study standardization in an environment where convergence is central is to conceptualize the communication platforms as Information Infrastructures (II). On the one hand, II gives us the conceptual lens with a focus on the heterogeneity of the actors as well as the open and socio-technical nature of the process. On the other, the prevailing institutionalized standardization practices and innovation regimes. With an emphasis on these factors and the tension between them the challenges of convergence and the need for flexible standardization processes, standardization institutions as well as standards emerges more clearly.

Methodologically, this paper primarily draws on interviews with central actors regarding the development of the CPA business model and the implementation of CPA-platforms in Norway. During 2003, interviews were conducted with the two Norwegian MTOs, six content providers, the Norwegian Post and Telecommunication Authority, the Norwegian Competition Authority as well as the branch organization for the content providers. The employees interviewed from the content

providers and MTOs were a mixture of technical and marketing people. The relevance of the chosen organizations and interview objects were identified during interviews commencing in one of the MTOs. The interviews were basically open ended, supported with a simple interview guide. In particular, the interviews were all focused around the development of the CPA standard and the industry of content services for mobile phones and the challenges it poses. While following the current development of the CPA market and its new applications, a reconstruction of the historical development since 1999 was provided by one of the MTOs.

## 2 INFORMATION INFRASTRUCTURE AND CONVERGENCE

Several researchers have used II theory to describe processes of standardization within organizations or communities of organizations (for example Ciborra and Failla 2000; Hanseth 2000; Monteiro 1998; Rolland 2003; Star and Ruhleder 1996). These contributions provide an understanding of standardization and standardization processes linked to local practices and institutions, factors not sufficiently captured with economic theories of standardization alone (for example Besen and Farrell 1994; Shapiro and Varian 1999; Succi et al. 1998). In this paper, II as a theoretical lens is applied on the industry-wide and public CPA standard, its standardization process as well as the central actors in this process. Inspired by earlier applications of II theory we put emphasis on the open, flexible and socio-technical nature of an ongoing standardization process.

While traditional telecommunication systems are vertically integrated and characterized by being closed and having a specific purpose for a limited repertoire of usages, the essential aspects of II is that they are a: "shared, evolving, open, standardized, heterogeneous and socio-technical construction" (Hanseth 2002, p. 7). An II, by its nature, serves a wide range of users, user communities and types of applications (for example Ciborra and associates 2000; McGarty 1992; Neumann and Star 1996). The II evolves through change, but at the same time, changes are always extensions of what already exists. This is not only related to the installed base of technology but also to innovation regimes, dominant designs, regulations, user practices etc. In the case of CPA, the ongoing changes are out of central control and appear as manifestations of the combination of agendas and actions of a variety of heterogeneous actors. As we also appreciate CPA as a flexible standard, we conceptualize the processes of standard making and diffusion into the marketplace not as distinct, but as interlinked and ongoing processes (Star and Ruhleder 1996).

Within standardization committees, the issue of openness is framed and control is achieved and maintained by creating a "closed" arena where the actors are homogeneous (Mansell 1990) and the agenda and participation is institutionalized (for example Schmidt and Werle 1998), even if the struggle with governments and their national policy and national industry interests related to the committee standardization of the NMT and the GMT shows that this is not necessarily a binary open or closed situation (Haug 2002; Manninen 2002). CPA is developing outside such institutional frameworks and the coordination among MTOs and between MTOs and content providers is played out on an open and unrestricted arena. With such a perspective, standardization is an open process, related to who and what is a part of the II, who is designing what and who has the power to determine the trajectory of the further developments. At the same time, this diversity is in it self a call for standard making as well as adoption of standards (Branscomb and Kahin 1996).

As telecommunication networks are the worlds' biggest systems, standards and standard-making is for them a crucial activity, and standards can be defined as "… abstract specifications of the necessary features of a component that make it compatible with the rest of a system" (Schmidt and Werle 1998, p. 3). Conceptualizations of telecommunication standards tend to focus on the level of entire systems, as for example NMT and GSM, describing standards for bandwidth, transmission frequencies, protocols, codes, signaling conventions, modulation procedures etc. (discussed by e.g. Fomin 2001; Manninen 2002). In this paper, we discuss standardization related to telecommunication, however not capturing an entire system or generation of mobile telecommunication, but related to the rather small-scale efforts of implementing CPA-platforms. With a focus on II as extensions of what already exists,

this is also a discussion of the GSM standard since a II has no end-point neither in time nor space (Star 1999). At the same time, our discussion takes into account a wide range of heterogeneous actors, as the ongoing standardization process requires successful coordination among MTOs, content providers and governmental institutions. These actors must on the one hand coordinate certain technical standards as interfaces to the CPA-platforms. On the other, and more important, they must also create non-technical standards to enable a transparent, open and easy to access market for content services.

Discussions related to standardization processes tends to see the standardization as either formal, de facto or de jure (for example Hanseth et al. 1996; West 2003). The standardization process we discuss does not necessarily fall into either of these categories, as it is not a result of formal procedures, evolutionary market selection or law-making by authorities. The process can be more appropriately conceptualized as a process where we recognize fragments of these categories, and where these fragments together provide the necessary support for the ongoing standardization process. When we study processes where technologies, markets, actors etc. that were previously independent and distinct, that now become integrated and mutually dependent, standardization reveals a process based on convergence through fragmentation. As the process is open, the power of participating and setting the agenda is fragmented and distributed, even if unevenly, and the assets, incentives and mechanisms driving standardization are dispersed among the different actors. The convergence process now surfacing related to CPA is not only based on how the different actors nurture and define their interests, but also is a redefinition of what the telecommunication and the content industry and technology is in itself, by blurring and moving the borders among them.

## 3      CASE STUDY OF THE CPA-PLATFORM AND BUSINESS MODEL IN NORWAY

### 3.1      CPA as a business model and platform

Content providers utilize the mobile telecommunication system as a transportation channel for content in the Norwegian market. They do however also need a cost-effective billing system to take care of the relative inexpensive services (limited to NOK 60 (€ 7), a limitation defined by the two MTO by their available rating classes. Content providers are also concerned with getting access to the whole national market of mobile subscribers. At the same time, MTOs do not define producing, marketing and branding content services as their business. Concerns about relating the brand of the MTO to non-utility services (and further "adult entertainment"), the challenge of pricing services correctly in the content market, as well as a history of sub-optimal walled garden approaches provides strong incentives for combining forces with content providers. Aligning their interests, the CPA standard meets the needs of both the MTOs and the content providers. In addition, it also provides the transparency and ease of use required by the mobile content consumers to create a prosperous market.

The MTOs make their value chain accessible to content providers through this arrangement based on a revenue sharing transaction model. Enabled by this standard, content providers reach economies of scale through easy access to the market, a viable billing solution as well as a possibility to brand through the use of short-codes (easy to remember phone numbers with only four digits). At the same time, the content providers offer innovative services and pricing policies related to entertainment and impulse consumption. They also have easy access to marketing channels, in particular as TV-broadcasters and "media windows". The nature of these services, being highly susceptible to changes related to trends, hypes and media events, also requires the standard and the platforms to be flexible so as not to hamper innovation.

The CPA-*platforms* offer an interface with two related services for content providers: a transportation service to handle requests and delivery of content, and a related service for billing the customers. The CPA *business model* refers to a broader context of actors, coordination and standardization important for the market success of CPA. Primarily, it is crucial that every mobile operator in the market

implements the platform to allow content providers to access the whole market of mobile subscribers as well as allow subscribers transparent and easy access to the services.

Buying content through CPA requires some simple steps for the customers. For example, if a customer would like to have the song "9 to 5" by Dolly Parton as new ring tone on his mobile phone, he will typically locate the required information for ordering the service on the web. The information needed for ordering the service are typically a phone-number (from where to order, for example 1985) and the content item name ("9to5" in this example). As a request for the service, the consumer sends an SMS containing "9to5" to the number 1985. The operator receives the SMS, recognizes the number 1985 and forwards the request as well as the customer' phone number to the content provider over a simple TCP/IP interface. The content provider receives the request, recognizes 9to5 as the item, and produces and returns the proper content back to the operator by TCP/IP together with the consumer' number and the contents rating class. The operator forwards the content back to the customer, and the content is charged on the regular mobile phone bill (accordingly for prepaid subscriptions) by the operator according to the rating class. Finally, when the customer pays his bill, the revenue is split between the operator and the content provider.

The CPA business model and its approach to meet the challenges of providing services to mobile phones in a market can be conceptualized as layers of standardization or coordination, together providing what is necessary to "build" the CPA-market. These layers are briefly summarized in table 1, and further described below.

| Billing services |
| --- |
| Marketing and branding |
| Transparent access for content providers and subscribers |
| Service innovation |

Table 1.Layers of standardization/coordination.

The primary challenge for content providers is the issue of billing. Implementing, operating and managing a billing system for the content providers is not sensible, in particular as the content in general is inexpensive. Numerous billing systems would also introduce cumbersome registration processes for the subscribers. With no real current alternatives, this is one of the key reasons behind content providers' actual willingness to go into a relationship with MTOs on the terms of a not very favourable revenue sharing model (the operator' share ranges from 30 to 60 percent). Providing a layer of accessible billing services, the MTOs provide a solution to the challenge of billing without adding any significant functionality to their own systems more than e.g. queuing mechanisms for peak hours. At the same time, the responsibility of rating the services is delegated to the content providers. This implies that the MTOs have no control over the content, but also the flexibility that new content and services are added independently by the content providers. However, the MOTs are not only driven by the needs of the content providers in the standardization process. For MTOs, the cost of advertising and marketing content services is very high, at least compared to content providers with close ties to the media industry. As mentioned, the content services provided for mobile phones are also services the MTOs not always find appropriate to relate to their brand. As the content providers take the responsibility of marketing the services, they also take the responsibility of branding the services despite their controversial character.

Nr 1. SMS-chat

Send LOVE to 2098

Only 1,50/SMS

Figure 1.The simplicity of advertising provided by CPA

Particularly related to marketing, but also ease of use and transparency, the CPA market is built on the concept that any subscriber is able to order the same service from the same short-code, for the same price. This makes marketing much simpler than if services, number and price varied from operator to operator, necessarily resulting in advertisement more resembling user manuals than trigging consumption. MTOs must coordinate to enable this: First, there must be interconnection between the MTOs so that service requests and services can be passed freely between the different networks. Second, they must define, together with regulatory authorities, certain short-code series for the content providers. Finally, they must agree upon certain rating classes and protocols for service billing, so that despite the operator the service has the same cost for the customer. Together, this facilitates ease of advertising and service access, as exemplified by the ad in figure 1.

Finally, the content sold by CPA is also not primarily created based on explicit needs from the users, but the needs are "created" by the introduction of innovative services. Being responsible for innovation, content providers have shown far more creativity than the MTOs. On the other hand, innovation is also problematic as the revenue on content is limited, an issue also related to the split between MTOs and content providers.

3.2     CPA as a process of innovations in the Norwegian market

In 1997, the two Norwegian MTOs provided a collection of utility services as news, stock quotes, weather forecasts and phone directories exclusively for their subscribers. As the MTOs were recognised as the provider of the content services, utility became important as the services referred to the MTOs' brand. Services as "adult entertainment" and XXX jokes were naturally excluded. The nature of content services for mobile phones has however shown to be strongly related to entertainment. Combined with the high cost of advertising for MTOs without their own "media window", the walled garden approaches became costly and not very successful endeavours. In addition, the customers had to struggle with a range of short-codes, price differences and exclusive content from different MTOs. Therefore, in 1999, one of the MTOs took an initiative to reduce cost, risk and responsibility related to their brand by developing a different approach resulting in the CPA standard of today.

While the decision to change approach was clear, the management efforts and the investment in further implementation of the platform was limited within the MTO. On a day-to-day basis, only a few key people still managed by initiative and a spirit of entrepreneurship to implement and attract content providers. Luckily, they found their counterpart in a small (only two employees) content provider, primarily providing simple jokes. This was exactly what the market wanted. Without any commercial campaigns and real changes in technology more than giving open access to the content providers and coordinating with the other MTO, the first content provider was introduced in spring 2000. CPA very soon became an economical success compared to the old platforms. However, it was not before summer 2001 that resources formally were designated and a CPA division defined.

The implementations of the CPA-platforms are continuously changed to accommodate a highly fluctuating market. In the period of January to May 2000 after the launch of the platform, the traffic increased modestly. However, when May had passed, and a range of smaller as well as larger and more experienced content providers entered the market, the traffic was ten-folded in one month. During the following one and a half years, the CPA platform was extended to serve the increasing traffic and usage, in particular with a flexible middleware platform handling queuing of messages.

3.3     Interactive TV with CPA as a return channel

The CPA business model requires MTOs and content providers to find common interests and align them. One important group of content providers are TV-broadcasters, as for example the Norwegian Broadcasting Corporation (Norsk Rikskringkasting). When NRK produces TV-shows nowadays, management has implemented the opportunity to require the show to include interactivity with the

viewers. Examples of interactivity are polls related to TV-debates and talent shows, viewers expressing their thoughts or questions related to a sports event, actively taking part in a TV-quiz or a chat.

With current available technology, mobile phones and SMS is the primary alternative together with wired phones enabling interactivity by providing a return channel for the viewers. CPA also provides the ease of use necessary to enable the viewers to impulsively take part in the TV-show. The service transparency introduced with CPA as well as the mobile phone penetration (Subscriptions per capita is 87.7% per July 2003 (http://www.npt.no)) in the Norwegian population also makes interactivity more or less available for all.

NRK is not directly connected to the MTOs, but uses two different service providers to handle SMS interfaces with the different MTOs. For NRK, there is no strong brand in the short-codes they use, and these are also related to the service providers (1987 and 2008). For NRK, the viewers have a much tighter relation to the TV-hosts than these numbers. There are also marginal revenues to collect for NRK, as it is split twice with MTOs and service providers. As a result of this, in combination with a concern that prices will drop in the future, they are continuously searching for different and more attractive return channels, both in terms of a higher revenue share but also more and stronger interactivity with the viewers.

## 4    DISCUSSION

In the case of CPA the MTOs have found common interests in an open garden and standardization approach. This appreciation of common needs is nurtured by one of the MTOs arranging an annual event for the content providers. The MTOs have also had a history of pro-activeness towards the content providers by providing the necessary support to enter the market. This role is however now taken by service providers with close relations to "media windows" as well as acting as integrators towards the different MTOs. At the same time, the development of CPA has challenged the history and the institutionalized practice of cooperation among MTOs and their institutionalized committee based standardization processes. As the standardization unfolds outside the framework of committees the common mechanisms for reconciling conflicting preferences are not present. The MTOs in the Norwegian market are daily in a fierce competition over subscribers and market shares which does not necessarily create an environment for cooperating more than necessary. This is reflected by one of the employees describing the relationship among the MTOs in creating and maintaining the CPA standard as "coordination, but *not* collaboration". At the same time the standard has successfully been developed and implemented. The technical implementation of the CPA-platforms by the different MTOs has not followed any particular standard regarding its interface to content providers or the idiosyncrasies of the billing systems of the MTOs. The implementations have also developed over time to accommodate changes necessary to meet the requirements of the market and the content providers. This has materialized, as for example, refined queuing functionality to cope with peak hours, in particular related to TV-shows with time critical SMS-voting. The flexibility in the CPA standard thus allows the coordination between the MTOs to be minimal and not primarily on a technical level. The non-technical nature of the standard in the sense that it is really only the short-codes and the rating classes that are formally defined also leaves flexibility to the technical implementation of the platforms as long as they provide the required service level. A more technical and thus tighter coupled solution would have made the coordination efforts more complex as well as it would have required more resources and stronger management support as well as attention.

CPA requires new and different institutions for coordination of activities, standardization of interfaces and market approaches. These institutions have to be flexible enough to accommodate the rapid change in the actors' constellations and the convergence of the different markets and technologies. The first content providers using the CPA standard had a history of delivering premium information/recorded services to wired telephones. As a part of the dot-com wave, a range of small and entrepreneur like actors from the software industry also entered the market, and lately actors with

strong relations to "media windows" have established a dominant position. Even if MTOs and the content providers are providing complementary services within the CPA regime of today, the content providers have to follow the principles and the pricing policies (with standard agreements) of the MTOs, preserving their control. The primary consequence of this, the content providers argue, is that it necessitates the content to be cheap and more important hampers further service development and innovation. CPA acts as an enabler and provides the only viable standard and business model for providing content services for mobile phones in the Norwegian market. For the content providers, there is not one common interface to the different MTOs, and they thus need one agreement with and one interface to each MTO. As a new MTO currently enters the Norwegian market, content providers must handle yet another agreement and interface. To ease the negotiation with multiple MTOs and interfaces, integrators are taking care of these issues for the content providers. On the one hand, this eases the burden of negotiation for the content providers, but on the other, a new category of actors have a stake in the process. The openness of the standard thus paradoxically limits the incentives and flexibility of innovation by being supported by integrators.

The markets for the service we have discussed here are primarily national. There are, however, strong reasons to believe that CPA based services increasingly will get an international character. To assist content providers in their international operations, a common national interface to CPA-platforms should be available. International content provision in addition to the increasingly international character of MTOs generates a need for international standards, even if the CPA-platform does not fall under the scope of institutionalized standardization practices. At the same time, the variety of services and the unpredictability of what kind of services users will adopt imply that the traditional hierarchical and time consuming specification driven model followed within telecommunication standardization will very likely not be feasible in this area. At the same time, telecommunication systems that cross national borders are global networks not controlled or coordinated by any single authority (Schmidt and Werle 1998) as there is no governance structure that can enforce standards globally (Funk and Methe 2001; Schmidt and Werle 1998). Thus, international standardization will call for other mechanisms. Similar national initiatives to standardize the market of content services for mobile phones, like CPA, is undergoing in several other countries, as for example, the Netherlands, Hungary, U.S. and China. A slightly different approach is the implementation of i-mode in Japan, where DoCoMo provides exclusive and screened services for their subscribers and thus not an open and industry-wide standard (e.g. Funk 2001). These standard and efforts related to the standardization process take different shapes and forms, in particular related to the history of cooperation among content providers, regulatory environment, the presence of content providers and the SMS-culture.

The implementation of CPA-platforms and the business model has largely happened without any intervention from the regulators and the authorities in general. Through distribution of short-codes (in the 1900 and 2000 series), the Norwegian Post and Telecommunication Authority (NPT) has had a supporting role in the negotiation between the MTOs. At the same time, NPT defines its mission as to secure access to high-quality telecommunication services to the end-users on the *level of transportation* through *ex-ante* regulation. By this limitation, based on implementation of EU legislation in the new Norwegian Telecommunication Act, content and thereby CPA is not the concern of NPT. The distinction between transportation and content is partly a preparation for convergence, as NPT in the future will continue to regulate telecommunication services, regardless of the kind of network of transportation. Even if the authorities represented by NPT have shown minor interest in the standardization process, they have still provided the crucial short-codes. At the same time, further needs for coordination becomes the responsibility of the different actors and the market.

As the CPA standard develops in an environment of convergence, standardization becomes fragmented. The standard is primarily a result of alignment through negotiations among different actors. At the same time, the development of CPA is highly dependent on developments and extensions of the GSM standards and the mobile phone itself, as for example the introduction of MMS (Multi Media Messaging) gives the opportunity to provide new services such as polyphonic ringtones. Thus, even though CPA is standardized outside committees, other parts of the infrastructure it builds

on are. And MTOs are involved in these standardization processes, as well as how to control and implement these in their networks. The presence of market forces in this environment is not strong since MTOs are providing the only feasible business model, and the nature of this model removes any competition in service repertoire and prising among MTOs. At the same time, however, the content providers are seeking new outlets as well as engaging in public discussions and forums to increase their bargaining power and share of the revenue.

For mobile subscribers, the CPA standard makes services transparently available despite which operator they subscribe to. At the same time, the focus of the services is not utility but primarily entertainment or very simple information consumer services. This is both a result of the pressure on the content providers to produce cheap content, and the nature of these consumer services as not necessarily meeting but rather creating fluctuating hypes and trends of user needs.

## 5    CONCLUSION

Through emphasis on standardization as an open, socio-technical and complex process of negotiations and alignments, its outcomes in technology and standards can be more clearly understood. Through ad-hoc negotiation, and not on the track of institutionalized telecommunication standardization, CPA is a shared standard and business model with related implementations among the MTOs and content providers in Norway. As an open process, the standardization is closely related to processes of convergence magnifying the conflict of interests among the different actors through its blurring of borders between businesses and assets. At the same time, new actors find their role and nurture their interests in the coordination activities. As a result of this, content providers struggle with a pricing regime and a multiplicity of interfaces handled by integrators, in practice leading to scarce revenues and further marginal service innovation.

The openness of the standardization process does not result in a process simply driven by market forces. Even if standardization institutions are not playing role in the process, the MTOs still play on their strong relation to standardization of the underlying GSM technology as well as their control over the access network and billing services. Content providers are free to add new services and concepts, but they have to play within the frames provided by the MTOs. The lack of an institutional environment is more prevalent when it comes to the coordination among the MTOs. However, as the standardization has happened on a non-technical level there has been no need to standardize the underlying billing systems of the MTOs.

Coping with increasing usages in peak-hours as well as brand new service concepts, the implementation and standardization process of the CPA-platform and business model has shown highly flexible. On the one hand facilitating service provision, on the other hand hampering further innovation, the sustainability of CPA and its standardization approach will only be evident over time. At the same time, introduction of competing alternatives will necessarily be provided by other actors, further increasing the network of heterogeneous actors that need to coordinate. As a presage, the standardization process related to CPA provides us with interesting scenarios related to the standardization challenges the next generation of mobile telecommunication systems will meet.

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APPENDIX II


Petter Nielsen and Leopoldo José Nhampossa

Internationalization of Information Infrastructures and Control: Cases from Mozambique and Norway.

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# Internationalization of Information Infrastructures and Control: Cases from Mozambique and Norway

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ABSTRACT

Based on the growing interest in internationalization in the information systems (IS) domain, this paper examines two attempts of internationalization. The first relates to a health information system for developing countries and the second concerns a telecommunication platform for premium rated SMS services. Discussing the experiences from these cases we use concepts from information infrastructure (II) as our theoretical and analytical lens. This analysis leads us to the articulation of an extended framework for theorizing and understanding the processes of internationalization. Our discussion engages with the inherent challenges of internationalizing IS, in particular the tensions related to control. Throughout the paper we will show that internationalization processes are highly contingent upon the IIs it is growing out from and into. The discussion will in particular concern the nature of standards and relations between the global and the local as well as the choice of a process or a product approach towards internationalization.

# 1. INTRODUCTION

In this paper we discuss internationalization of information systems (IS) as a process with the aim to support the reuse of technical and human resources and building and sharing of knowledge across national borders. Accordingly, internationalization is pursued with the aim to reduce the costs of developing as well as implementing an IS as compared with starting from scratch in a new national context. Very much in line with current globalization processes, system development organizations are working to get and support the access to larger and possibly global markets. At the same time, new constellations of organizations such as multi-nationals are increasingly seeking to pursue international synergies on their disparate, scattered and disintegrated IS investments (Buss 1982). Internationalization is however a challenging endeavor, not only when linking developing and developed countries (for example Odedra-Straub 1992), but also within these different worlds.

The software design discipline has for decades discussed and appropriated the need for flexibility and compatibility. Decomposition and modularization, or loose coupling and close cohesion (e.g. Yourdon and Constantine 1979) have been identified as approaches to cope with the complex software systems. Based on these insights, researchers have engaged in providing adequate support for internationalization of software systems (for example Coronado and Livermore 2001; O'Donnell 1994; Russo and Boor 1993). Internationalization is understood as developing software systems to support localization, and ensuring their smooth adaptation in a specific national locale, for example to its different language, standards, legal requirements and cultural norms.

Management and development of international information systems (IIS) as a product have been discussed by organizational sciences as challenging for multinational corporations and their executives. Research in the IS field has addressed the variety of challenges related to standardization of inter- and intra-organizational IS in the strive towards universality and in particular to strengthen centralized control in global organizations (for example Ciborra et al. 2000; Ives and Jarvenpaa 1991; Rolland and Monteiro 2002). Drawing upon the lessons from software design, these studies have in particular illustrated how control over large scale systems can be challenged by lack of modularization and in particular local variations in system implementations and work practices. Applying a socio-technical perspective, these studies have illustrated that control is in tension with flexibility, and that managing this balance is also related to issues such as diffusion of standards (Hanseth et al. 1996) and the inevitability of situated work practices (Ellingsen and Monteiro 2003). However, little attention has been given to internationalization as a process as well as to the unique contextual issues such as existing and available technologies, human resources and work practices where the IIS is to be localized and implemented.

The research reported here is based on two case studies of internationalization initiatives. The first case is related to a health information system, the District Health Information System (DHIS), developed in South Africa and its process of internationalization and implementation in Mozambique. The second case concerns a telecommunication platform for premium rated SMS services, the Content Provider Access (CPA) platform, developed in Norway and its process of internationalization and implementation in countries such as Denmark, Malaysia, Hungary, Ukraine, Thailand and Bangladesh. These cases are dissimilar in context, conditions, content and results. However, both cases represent initiatives with the same aim of internationalizing ISs, and thus allow us to get some relevant insights in the related processes and approaches. While we relate our discussions to the referred studies concerning standardization in the IS field, the ISs discussed here are by nature nationally fragmented and independent and the challenges of control are thus not related to attaining and sustaining organization-wide and centralized control. We primarily discuss control as the challenge of on the one hand implementing and preserving global standards and on the other implementing standards locally in a context sensitive manner.

The primary aim of this paper is to contribute with new conceptual insights in the challenges of internationalization processes and specially related to issues of control. Our primary research question is how internationalization relates to the context which it is growing out from and into. We will more particular focus on how approaches vary between internationalization of products and processes as well as how control in internationalization is pursued through standards and relations. Focusing on the balance between the local and global challenges related to universal solutions (Bowker and Star 1999; Rolland and Monteiro 2002), we engage in the discussion of the different facets of control.

The rest of this paper is organized as follows. In the following section we briefly discuss the theoretical basis followed by the introduction of the two case studies in section 3. Section 4 provides an analysis and discussion of the cases based on the theoretical perspective. Finally, in section 5 we conclude by drawing some theoretical as well as practical implications.

## 2. THEORETICAL BASIS: INFORMATION INFRASTRUCTURES

In this paper, we discuss internationalization with an II perspective, understanding the ISs as intrinsically composed of, interdependent and interconnected with collections of socio-technical components (e.g. Hanseth 2000; Hanseth and Monteiro 1997; Hanseth et al. 1996; Star and Ruhleder 1996). IIs are thus not relatively simple, standalone and self-contained systems, but rather represent large and open socio-technical networks of heterogeneous actors. These actors have different perspectives on and only partially control over the II (Neumann and Star 1996; Star and Ruhleder 1996). This perspective provides us with the means to study internationalization as a process framed within socio-technical networks. As we move beyond issues of centralized management and technical software engineering, this perspective help us recognize internationalization processes as necessarily both related to product and process and means of control spanning from standards to relations.

As internationalization necessarily involves several of these networks, i.e. the network where the IIS was initially developed and grows out from and the various local networks which it is growing into, internationalization processes are intrinsically complex as any centralized efforts of control only effects parts of the networks. It is thus highly challenging, yet essential to overcome the tensions with past infrastructures, procedures and practices (Timmermans and Berg 1997) by not being "installed base hostile" (Hanseth et al. 1996). Internationalization is therefore a process of cultivating the installed bases of the involved IIs. At the same time, the nature of these installed bases is highly influential in shaping the possibilities of control in internationalization processes on the global as well as the local level.

Standardization serves both as a mechanism for control and also introduces tension between the global and the local (for example Hanseth and Braa 2000; Rolland and Monteiro 2002). In internationalization, lack of standardization in local implementations will render impossible scalable control and further sustainable reuse. At the same time, the simplicity and efficiency of an internationally uniform solution from a global perspective can easily become suboptimal locally (Damsgaard and Truex 2000). However, control can also be attained and maintained through formal or informal relations between the global and the local actors. Based on the available means of control, this choice between global and locally optimal solutions in the relationship between IIS and its local implementations (LocalIS) must in any case be balanced, what Rolland and Monteiro describe as the "pragmatic balance".

## 3. CASE DESCRIPTIONS

The empirical materials we draw upon here originate from two independent case studies conducted by the authors respectively. The first case is based on an in-depth study of the development and the current operation of a platform for premium rated SMS services for mobile phones (the CPA platform) in Norway and related internationalization attempts. During 2003 and 2004, 39 semi-structured interviews where conducted with a variety of actors related to the CPA platform. While some interviews were conducted among Norwegian actors only involved with the implementation of the platform in Norway, other interviews concerned employees occupied with the internationalization process pursued by MobiNor, as well as those working with the implementation of the CPA platform in the affiliates of MobiNor in Denmark, Malaysia, Hungary, Ukraine, Thailand and Bangladesh. The second case study was conducted from 2000 to 2003 as part of an action research effort in a global research and development program known as Health Information System Project (HISP) (Braa et al. 2001). The fieldwork included working within a multidisciplinary team in Mozambique and making two visits to South Africa to interact with the software development team as well as attending a locally organized summer school.

### 3.1. Internationalizing a platform for premium rated SMS services

In 1999, the mobile phone network operators in Norway launched their CPA platform, enabling premium rated SMS services. The technical CPA platform builds on a business model which enables content providers to sell content directly to mobile phone subscribers through the mobile phone network, by the network operators allowing for premium rated SMS messages, i.e. enabling content providers to charge subscribers more than the cost of regular peer-to-peer SMS services. Based on the two different network operators coordinating common short codes, price classes as well as a common service level, ease of access as well as a transparent market for the content was created. The operators did thus not choose to compete on differentiation with services exclusive provided in one of the networks, but on the contrary pursued an "open garden" approach. Branded and advertised by the content providers, the content becomes easy to use as any subscriber can order the content from the same short code for the same price. The typical content sold through the CPA platform comprises mobile phone ringtones and screensavers, jokes, Java games, news information, traffic information, weather information and phone directory services.

Content acquisition by subscribers is simply based on mobile phone subscribers requesting content by sending an SMS (Short Message Service) (figure 1) message. The SMS is processed by the SMS-centre (SMSC) of the network operator and forwarded to the content provider by the CPA platform. Upon request, the content provider returns the content by the CPA platform, and accordingly the cost which the subscriber is to be billed is specified with a rating class. Based on this, a billing request is sent by CPA to the billing system of the operator. The revenue generated is shared between the network operator and the content provider as per an agreed revenue-sharing model.
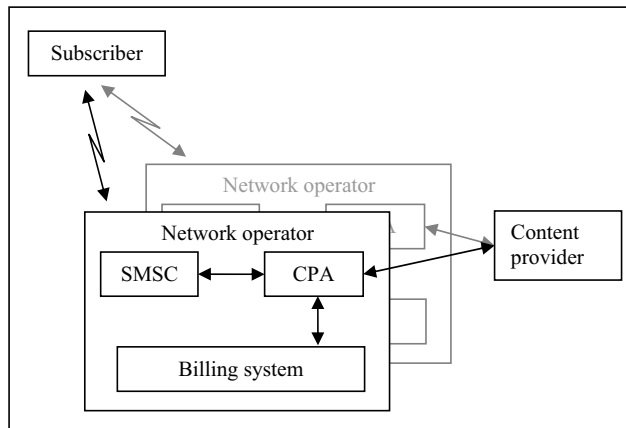


**Figure 1 The basic components of the CPA platforms**

The technical implementation of the CPA platform by one of the network operators, MobiNor, was based on a bottom-up initiative taken by a few key employees and drew upon relatively few resources. Only these employees really believed then in the underlying idea. Since MobiNor did not allow for an "open garden" approach, the implementation did not only lack management support but also violated the business and competitive strategies. However, coordination with employees from the other network operator as well as potential content providers quickly led to a successful platform and market for premium rated SMS services. The key challenge during this period was to create and maintain coordination between these actors as well as to develop a common appreciation of the platform. The platform implemented by MobiNor was technically an extension of an already existing facility for providing content services which was integrated with the billing system and the SMSC. The old platform, however, did not provide open access for content providers as well as a business model only providing exclusive content for MobiNor subscribers.

As the result of the continuous process of identifying interesting concepts for internationalization, CPA was in 2001 identified by the international division of MobiNor as an appealing platform for implementation in its various globally dispersed affiliates. This was only one project among others dealt with by this synergy area, and close related to the process of turning from a financial investor to an industrial investor towards the affiliates. Representatives of MobiNor traveled the affiliates' locations to introduce the platform and a related business case, as well as to provide consultancy services where required. This process was not based on internationalizing CPA as a software platform, at least partly as a result of recent failed attempts of internationalizing similar platforms. On the contrary, a "sharing of best practices" approach was adopted. Following this approach, personnel from Norway interacted with affiliates based on their knowledge of the platform's operations in the Norwegian context. This best practice has since been formalized as "12 guidelines for best practice", describing the need for an "open garden" approach, a symbiotic relationship between network operators and content providers as well as the ease of its use.

Affiliates situated in Bangladesh, Denmark, Hungary, Malaysia, Russia, Sweden, Thailand and Ukraine had implemented the platform by 2004. These affiliates have their own history and have adopted locally suitable approaches to provide premium rated SMS services while taking into account the national contexts, such as the maturity of the telecommunication market, the relationship among network operators and between network operators and content providers as well as the concerned regulatory regimes. These locally inspired (and, therefore different) implementations of CPA, reflects varying degrees of success. These differences are exemplified in the following examples.

Most affiliates offer mobile originating billing (MT-billing), i.e. billing the subscriber on the receipt of the content as shown in figure 1. Some of the network operators do, however, consider it more appropriate to base their billing on the subscribers' request of content (MO-billing). Technically, the former is enables different models of billing, such as subscriptions to daily weather forecasts or receiving alerts when stock prices cross a certain threshold. MO-billing, on the other hand, renders it impossible to rate requests sent to the same number differently. This limits the flexibility available to content providers and adversely impacts ease of acquisition, thereby attenuating the potential for CPA's success envisioned in the guidelines.

Some sort of proactiveness from the network operators towards the content providers and an entrepreneurship-spirited approach by the latter are required to create a prosperous CPA market. Companies based in countries where content providers were not flourishing suffered from lack of content services and a weak market, such as in Thailand and Hungary. This was in sharp contrast to the situation prevailing in other markets, where a range of small entrepreneur spirited content providers were active in the market, both before and after the CPA business model was introduced, e.g. in Malaysia.

The maturity of the telecommunication market related to CPA is in particular dependent on the relationship between the network operators. In some of the markets where the network operators have had a long and fruitful history of cooperation (as in the case of Norway), while in some others, a "walled gardens" approach has been further exacerbated by strong mistrust among them. In one affiliate, cooperation among network operators was spurred by the content providers in context of the CPA, but no agreements to create a permanent open standard could be reached. In addition, the absence of informal interaction between the network operators thwarts coordination efforts.

The local implementations of CPA appear differently and have shown a highly varying degree of success. With an approach to internationalize on the level of best practices, and understanding CPA as closely linked to the variety of local IIs, this do not come as a surprise. The key aspects of the internationalization process are summarized in table 1.

**Table 1 Key aspects of the CPA internationalization process**

| |
|---|
| Platform based on bottom-up initiative, coordination among network operators and between network operators and content providers. MobiNor not in control in Norway, and affiliates not in control locally |
| No-standardized product, only visiting consultants from MobiNor. Non-standardized process in different in local contexts, and guidelines only describing "best practice" in Norway |
| The local implementations (as well as the original CPA platform) are thus highly dependent on the installed base of e.g. cooperation among operators and their proactiveness towards content providers as well as the existing billing systems and SMSCs. |

3.2. Internationalizing a district health information system for developing countries

Initiated under the Health Information System Project (HISP), the district level computer-based health information system (DHIS) for processing of data received from Primary Health Units (PHU) was accepted as a national standard in South Africa in 1997. Together with an underlying open source philosophy driven by the overall goal to achieve equity in health, a participatory and bottom-up approach was seen as essential in its development (Braa and Hedberg 2000). Over the years, the DHIS has been regularly updated and its functionalities improved as per emerging management/community needs. Later versions have also taken advantage of the ongoing developments in hardware and software technologies, for example by way of designing more effective visual interfaces, incorporation of query-based reporting etc.

The DHIS combines both routine data from the health services and semi-permanent data on the health facilities like number of beds, equipment, staff, budget, population, etc. These types of data (also called denominator data) are linked to the indicators engine which allows defining and calculating indicators on any combination of data elements using the numerator/denominator framework. An important activity in the implementation of DHIS in South Africa was to identify the essential dataset (EDS) to provide an effective template for data collection by PHUs. The composition of EDS was finalized through a participatory process of consultations involving policy makers, health workers, computer system designers and communities. Acceptance of EDS by these stakeholders eliminated earlier redundancies in data collection, pinned down responsibility for collection and update of data elements, while also providing an unambiguous framework to generate various reports at frequencies and formats desired by managers and other users.

In 1999, the HISP initiative was taken up in Mozambique. Based on it successful implementation in South Africa, as well as it emphasis on decentralization and participatory design, its strategies, processes and tools such as DHIS was transferred. Even if based on a success story from South Africa, the need for a deep understanding of the context including the health structures and information processes was identified. Priority was given to creating local teams and enrolling researchers and practitioners to undertake the localization process with central support from South Africa. The responsibility of the HISP team in South Africa is thus both to serve the local implementations of DHIS as well as to support a broader network. Since DHIS is based on open source, the users had full access to the source code, and could introduce changes according to their needs and local conditions. They were also allowed to freely revise the source code as well as redistribute it (Braa and Hedberg 2000; Braa and Hedberg 2002).

DHIS was initially not internationalized before its transfer to and piloting in Mozambique, simply because it was not originally meant to be used in contexts other than South Africa. The initial releases were thus designed and implemented to meet the language, format, culture and regulation requirements of South Africa. The change of strategy to also include internationalization suggested that the piloting now should involve support for localization, including changes related to e.g. creating a modularized and three tier architecture of user interface, functionality and database as well as adding new modules or other features. Several localization challenges were experienced, for example, the structure of the database reflecting the five levels of units in the South African health systems had to be changed to accommodate for the four levels in Mozambique. Other aspects related to language (Portuguese), naming conventions, hierarchical structure and levels also needed to be defined as starting point, at the level of the database, the user interface and the reports.

The adaptation of DHIS in Mozambique does not follow a remove-replace but rather an add-on strategy whereby e.g. new language support was added without modifying the original software. Since technical support was absent in Mozambique, all changes to the software were sent to South Africa for the manufacture of a setup CD. New CDs from South Africa acted as a new release with newly added features and bugs fixed. The testing of the new release was conducted in the piloting sites, and further changes required were sent back to the main hub in South Africa, where the setup CD was again manufactured and subsequently sent back to Mozambique for testing and use.

The multiple adapted release cycles of the DHIS software suggested an endless process of interaction (with South Africa), whereby the integration of the new releases implied starting more or less from scratch. The new initiatives and features locally implemented in Mozambique are at the same time not necessarily relevant and even compatible to the new releases generated for internal use in South Africa. At the same time, however, the initiatives taken up have contributed to the global DHIS software. Although at a conceptual level the continuous release cycles with South Africa could be discarded in the favor of an autonomous approach, in practical terms such procedure was not feasible in Mozambique. The nature of interaction between Mozambique and South Africa, emphasizing collaboration and sharing of experiences have up until now developed a stable and mutually beneficial long term relation.

The key aspects of the DHIS internationalization process are summarized in table 3.

**Table 2 Key aspects of the DHIS internationalization process**

| |
|---|
| Standardized and centrally controlled DHIS software by South Africa, but also bottom-up, participatory and open source implementation approach locally |
| Software not internationalized initially but over time. Bottom-up and user centered development leads to no standardization on process |
| The implementations of DHIS highly dependent on the installed base of e.g. technical and human resources available in Mozambique as well as the specificities of language, the health care system and the local practices |

4. ANALYSIS AND DISCUSSION
Different in context, conditions, content and results, the CPA and DHIS cases point to a variety of challenges related to the process of internationalization. While following different models and based on different standards and relations between the global and the local, these cases in particular illustrate internationalization processes as being continuously struggling with its interrelated IIs and its related tensions of control.

4.1. Control through standards and relations
Even if a process of internationalization have been pursued in both the CPA and the DHIS case, the nature of the local implementation are not simply controlled and determined globally by Norway and South Africa

respectively. While MobiNor have pursued an approach without any technical standards resulting in little if any centralized control, South Africa has controlled the development of DHIS to a larger extent by centrally producing standardized software.

Since the content of internationalization has been kept at the level of providing guidelines in the case of CPA, the benefits accruing from this process are lesser as compared to the software development scenario in the case of HISP. The reasons why MobiNor have not followed a more rewarding internationalization process in terms of synergies can on the one hand be attributed to the history of the relationship between MobiNor and its affiliates, which has primarily been based on financial investments. On the other hand, this approach can also be attributed to the close technical relationship between CPA and the local implementation of the SMSC and the billing system. A technically standardized CPA platform would not only impact these platforms, but also require other actors in the local markets to adhere to the standard. While agreements have been made over time between these actors in the local markets, none of the affiliates of MobiNor have been able to impose one standard in their local context. Control is thus not only a local-global issue, but is diffused over a network including the affiliates and their control in the local context. The important roles of the installed base (in particular technology and human resources) also applies to the HISP case, where the global team (in South Africa) has little power when it comes to the actual implementation and use of the software out in the field.

Where standards as a means of control are not applicable, however, control can also be exercised by the relations between the global and the local actors. These relations are shaped by aspects such as resources available locally, history of cooperation, and distance between the actors. For example, in Mozambique, the key people related to the development and implementation of DHIS is not permanent field staff but primarily PhD students working part-time for the HISP project. Thus, Mozambique has been dependent upon the support from South Africa even if local resources slowly develop over time. On the contrary, the relations in the case of CPA have been weak and the initiative from MobiNor has been continuously challenged not by the lack, but rather by the presence of resources and local initiatives originating from the affiliates. Some affiliates have also been reluctant to seek support from MobiNor, but rather from other sources such as successful Norwegian content providers. Based on experiences with earlier attempts of internationalization, the risk of disfranchising the local technology and initiatives have been one important factor deciding the soft approach pursued by MobiNor.

The choice of approach of internationalization, e.g. through standards or relations and their inter linkage, is strongly related to the history as well as the means of control. The local installed bases of components, such as technology, human resources as well as the relationship between the local actors are strong determinants when it comes to creating feasible approaches. Where the installed base is weak, as in the case of Mozambique, control can be easier to achieve through standards than in the case of CPA where the installed base is complex.

4.2. The tension between flexibility and standardization
In the case of HISP, a key issue is how to centrally incorporate and locally align software and processes introducing participatory design and creating flexible software solutions based on an open-source philosophy. This was not easy to achieve as the three-tier architecture implemented in the DHIS software suggests that data storage, user interface and functionality are separate entities. This flexibility does, however, allow Mozambique to introduce changes to any of the three levels. The question thus raised is which aspects should be under local and which should be under global control? Further, this points out how using a standardized process, i.e. participatory design, results in a non-standardized product. This complexity related to internationalization is further illustrated by the case of CPA where the guidelines for best practice only describe the principles adopted for its success in Norway. The guidelines do, however, not describe how to build the network of actors from bottom-up, pursue management to engage in an "open garden" approach and settle the relationships among the network operators.

The flexible approach in the CPA case can be argued as being appropriate for different contexts, by reflecting sensitivity to the rather heterogeneous contexts of implementation. However, such an approach has lead to unstructured situation in which some of the LocalIS do violate the very rules of the best practice. In particular, due to reluctance of the network operators to adopt an "open garden" approach, the suggested coordination to develop the platform has failed. Facing the challenges of linking the various affiliates together to create synergies, MobiNor is currently in the process of planning to standardize other technologies and platforms, such as the SMSC and billing systems, both closely linked to the CPA platforms. Even if the managerial focus is currently not on the CPA, future progress on standardizing other platforms may lead to a need for a global CPA standard. However, taking into account the various existing IIs, we should also understand each implementation of CPA as framed within and sensitively adjusted to a local network of already existing components. The

affiliates' local struggle with controlling this network can be equally or even more challenging than the globally initiated internationalization process as well as other standardization initiatives.

Standardized implementation processes may lead to non-standardized products. When approaches focused on being context sensitive, e.g. bottom-up and participatory, are applied, flexibility will be pursued at the cost of standardization and global control. In such cases, however, the relations between the global and the local can play an important role in coordinating the internationalization process towards a standardized outcome.

### 4.3. Internationalizing Information infrastructures

In our discussion, we have extended a relatively simple model of software transfer and pointed out various facets of control in the relationship between IIS and LocalIS. The distinction between the process of internationalizing and local implementations tend to become less clear, and their relationship also stretches back to the legacy of the initial IS as well as forward to local adaptations. As II develops over time as an intricate and heterogeneous network of actors, internationalization initiatives can be highly complex and further limited in their achievements. For example, in the case of CPA, the nature of the platform is very much dependent on the nature of the billing system and the SMSC of MobiNor, as well as of the other network operators in Norway. In addition, the informal relationships amongst the network operators and between them and the content providers have been decisive for its implementations. These relationships are impossible to internationalize. In parallel, DHIS has to struggle with the local specificities of language and the hierarchical structure of the health sector, suggesting the need for DHIS to be conservatively designed to allow for these local adaptations.

The implementation of DHIS is highly dependent on the installed base of e.g. technical and human resources available in Mozambique as well as the specificities of the health care system and the local practices, while the local implementations of CPA are largely dependent on the cooperation among operators and their proactiveness towards content providers as well as the existing billing systems and SMSCs. At the same time, however, attempts to implement LocalIS will not automatically succeed if all resources, actors and components are present as the coordination between them will develop and shape over time. Thus, the challenges of control related to internationalization is not only related to a global perspective but also, and probably more important, to the local.

### 5. IMPLICATIONS

Applying an II perspective has helped to lift the discussion of internationalization from a technical perspective to a socio-technical perspective situated in a context defined by both local and global influences and relations. Our implications in the form of two models (figure 2) abstract different approaches to internationalization. Model 1 illustrates how IIS not necessarily are developed from scratch, but spawned by an already existing IS and it's surrounding and interrelated IIs as we have pointed out in the case of DHIS. Model 2 illustrates how localization can also take place directly from an IS, and thus with less flexibility and support for reuse as in the cases of CPA and DHIS initially. Model 2 is thus highly contingent upon the presence and continuity of locally available human resources and competencies.
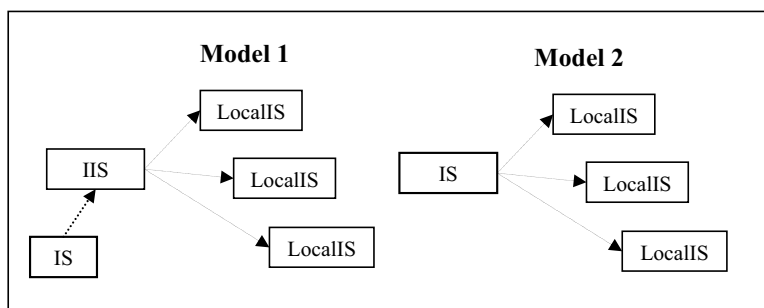


**Figure 2 Extended models of internationalization**

While these models are very different related to the interaction between the IIS and its various local implementations, internationalization processes can over time change from one model to the other. In the case of HISP, initial attempts of internationalization directly from an IS in Mozambique, as in model 2, over time brought out the necessity for an IIS and the process was changed to model 1. While CPA have followed model 2, a further internationalization of platforms such as the SMSCs and billing systems could lead to the revival of model 1.

In this paper we have shown that internationalization of ISs is a highly complex endeavor involving not only technology, but also human resource capacity, relations and IIs. This process is close related to controlling the relationship between the global and the local. At the same time we have illustrated how local implementations of internationalized products and processes cannot escape local IIs. These local socio-technical networks play an important role on the means, the freedom and the needs for internationalization and more particular control at the global and local level.

Internationalization and localization should neither be understood nor treated as different and subsequent processes. Such a distinction does not take into account the interrelatedness of internationalization processes and can easily mislead us to interpret internationalization success or failure as solely determined by centralized efforts of internationalization and control. Even if the very end of an internationalized IS is not meant to be one centralized system, we should also understand each local implementation as a part of a larger network. In particular to capture internationalization as being a process, the universality (if any) of the network cannot be developed by introducing one standardized solution. Our discussion suggests that the global - local relationship and the tension between the control (through standardization and relations) and flexibility must be balanced reciprocally and pragmatically between the local and the global over time. To practically approach internationalization, we suggest to exercise control through a blend of standards and relations. At the same time, and most challenging, this process of blending will not solely rest with one, central actor, but will be distributed across the socio-technical network.

Internationalization aims to support the reuse of technical and human resources. However, the consequences of internationalization for local human resource development are uncertain, in particular depending on whether internationalization is pursued by process or product strategies. A standardized product strategy will not necessarily aid local human resource development because it will require less of such local competencies. Where internationalization is pursued with a more flexible and open process strategy, local competencies will necessarily have to be in place, engaged and developed in the process of localization. We argue that while choosing between process and product strategies, in particular related to the degree of standardization, the consequences for human resource development must be taken into consideration.

While internationalization will have consequences for human resource development, it will also be shaped by the existing human resource capacities. The adversary conditions of developing country contexts call for strengthening human and technical resources, while at the same time this "void" can enable the ISs to be built from scratch. One should however be cautious to interpret a "void" of technical infrastructure as a "void" of social networks and practices. At the same time, presence of technology and knowledge is not necessarily the optimal condition for successful internationalization since changing socio-technical networks are maybe more challenging than creating them.

While standards and networks of relations in internationalization can transport products and processes, the stability of the standard and network itself will be highly dependent upon which support is provided by those promoting and supporting internationalization. While our perspective does not give one recipe for how to blend control in internationalization processes, it directs us towards understanding ISs as parts of larger global and local IIs with their own history, content and trajectory.

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APPENDIX III

Arild Jansen and Petter Nielsen

Theorizing Convergence: Co-Evolution of Information Infrastructures.

# Theorizing Convergence: Co-Evolution of Information Infrastructures

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**Abstract.** This paper engages in a study of the conditions for convergence between information infrastructures. Inspired by the visions of convergence as one of the essential building blocks to achieve the goals of the Information Society and eEurope as well as the observation that no model has been proposed to address how and why convergence develops, we aim at providing a theoretical framework for studying such phenomena. To analyze the interrelatedness of the parallel evolution of information infrastructures, we introduce a concept of co-evolution and apply it to a study of the ongoing development of the two wireless communication platforms Universal Mobile Telephone System (UMTS) and Wireless Local Area Network (WLAN) in Norway. We emphasize the importance of an adequate understanding of the infrastructures involved, including the installed bases and their intra- and inter-linkages, to anticipate possible trajectories of co-evolution. Focusing on the network dimension of the communication platforms, we show how the various technologies, politics, interests and user preferences linked to the installed bases of each of the platforms may strongly influence the direction and speed of their co-evolution.

*Keywords* Co-evolution, convergence, information infrastructure, installed base, UMTS, WLAN.

# 1 Introduction

Due to the ongoing digitalization of all types of data, multimedia and telecommunication networks, convergence has become an increasingly important issue, not least in the political arena. The common understanding of convergence is illustrated by Andrew Odlyzko: "… in which computing, telecommunications, and broadcasting all merge into a single stream of discrete bits carried on the same ubiquitous network" (Odlyzko 2001, p. 1). Even if we do not fully subscribe to this vision, in particular because we see the process of merging as uncertain and contingent, it is clear that there will be substantial implications of the technological developments in the ICT sector in the years to come.

The commission of the European Union (EU) as well as the Norwegian authorities currently recognize convergence as a cornerstone in: "… the strategy to make the European Union the most competitive and dynamic knowledge-based economy with improved employment and social cohesion by 2010, as well as enabling the implementation of the Information Society for all" (COM 2002a). EU and European national strategies and action plans have therefore been focused on how to stimulate convergence, in particular as it is seen to be vital for the further development of the European economy. Through their description of the key challenges of realizing convergence, however, it seems like they view convergence as something achievable through political initiatives and stimulation such as deregulation, standardization and harmonization nationally and across Europe. At the same time they put limited emphasis on the characteristics of the involved technologies and their specific implementations.

We argue that the prevailing political visions are based on a far too simplistic understanding of the development of ICTs. They apparently express a flavour of determinism by understanding convergence as a given or predetermined process, and not as only one possible result of a range of highly political and uncertain processes. Our point of departure is rather the opposite, claiming that there are politics and diverging forces involved in the development and implementation of ICTs in general and in particular in the evolution of communication platforms. We rather see convergence as a possible outcome of a *co-evolution*[1] by which we understand the parallel and simultaneous evolution of distinct, still interrelated ICT platforms. In this process, the platforms mutually influence each other in ways which can not be fully anticipated. In our empirical study, we investigate the co-evolution of the two communication platforms UMTS and WLAN as they evolve through a complex interplay of processes. The further direction of this co-evolution can be

anything on a continuum from full integration to divergence. A possible close integration of the platforms may also take many forms, in particular since their evolution is driven by different actors with a variety of interests, agendas and preferences.

As a theoretical tool for studying the nature of the evolution of communication platforms, we apply information infrastructure (II) theory. Infrastructure are characterized as *large, shared, open, standardized* and *heterogeneous* networks of socio-technical actors (McGarty 1992; Star and Ruhleder 1996). In particular we understand infrastructures as *evolving* (Hanseth and Monteiro 1998) and accordingly having an essentially historical character, implying that changes are related to what already exists (David 1985). We thus put emphasis on the significance as well as the constituents and structure of their *installed bases*. Inspired by a *relational perspective* (Star and Ruhleder 1996) of the evolution of infrastructures, we further distinguish between the *demand-side* of installed base, which is composed of the user preferences, practices and investments, and the *supply-side*, which is composed of the ICT providers' investments and preferences related to design, implementation and diffusion. Further, the installed bases are interlinked with and influenced by other infrastructures in their evolution. We argue that our co-evolution process framework will provide analytical support to understand these interrelationships.

The anticipated convergence between the communication platforms WLAN and UMTS has been much debated in the trade press as well as the telecommunication- and computer-science literature (e.g., Jaseemuddin 2003; Lehr and McKnight 2003). While UMTS represents the next generation mobile telephony, building on a vertically integrated set of protocols, WLAN extends the reach of local area networks based on open Internet standards. In this paper, we demonstrate how our theoretical framework supports a deeper understanding of the factors that will influence their future co-evolution. By comparing UMTS and WLAN as ICT platforms we show how the analysis of co-evolution benefits from capturing the dynamics of these platforms, both on the demand and supply side, as well as the interaction between the two.

When introducing the concept of co-evolution, we do not argue against convergence as such. We rather argue that the trajectories of communication platforms (as for example UMTS and WLAN) are strongly influenced by both converging and diverging forces, and that a possible final integration will follow patterns that are not easily anticipated. This directs us towards two central questions; firstly, what enables co-evolution to turn into convergence, and what may be the obstacles associated with this, and secondly, to what extent do the various communication platforms have to change or break with their installed base to enable convergence?

This paper has primarily two objectives. First, we aim to develop a theoretical process framework to help understand the evolution and co-evolution of information infrastructures. Second, we further demonstrate how this theoretical framework supports an analysis of the anticipated co-evolution of UMTS and WLAN.

## 1.1  Empirical Research Approach

Our study belongs to the interpretative IS research tradition (Meyers and Avison 2002; Walsham 1993). Our research objective is to gain more insight into the dynamics of information infrastructure developments by taking into account the constituencies of UMTS and WLAN as well as their context. Our research has had a hermeneutic character in that we have iterated between studying parts and the whole (Klein and Myers 1999). On the one hand, we have focused on the rather detailed technical matters of the two platforms, on the other, the corresponding overall political and institutional framework and market conditions in which the platforms have been planned, designed and implemented.

The empirical data presented is based on case studies. According to Yin, a case study "investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (Yin 2003, p. 13). The two communication platforms were selected primarily for two reasons. Firstly, as stated above, because their convergence had been anticipated and discussed. Secondly, the choice was also motivated by their similarities as well as their differences. While both platforms can be understood as providing wireless access to mobile users for slightly different purposes and in a complementary manner, they can also be seen as competing and engaged in a battle of systems (Hughes 1983). Thus, these two platforms appeared to us as particularly suited for a study of convergence.

We have followed the development and implementation processes of the UMTS and WLAN[2] in Norway from 2002 to 2004. Even though it can be argued that their development trajectories have been different in other countries, we believe that the basic international character of both platforms prevents significant national peculiarities, at least in Europe The same standards have been adopted across Europe; the user terminals (mobile phones, PDA's, PCs etc.) have only limited national adaptations; and the communication networks rely on smooth international interoperability. We have focused on a limited part of the infrastructures and their context, and their effect on the process of co-evolution, leaving out other factors that may influence their future evo-

lution. This is at the same time the very nature of IIs; as they reach out in a variety of directions it is not possible to have the overview since there is no overview to have (Neumann and Star 1996).

The data collected are primarily qualitative; however supplemented by facts about key actors, technical characteristics, standards along with the political vision and action plans, the status regarding the implementation and the common use of these platforms. The data is filtered through our understanding of the existing institutional context, prevailing policies and the strategies of the involved actors. The data collection across various sources was chosen because it is particularly useful in theory generation since it provides multiple perspectives on the case under investigation (Eisenhardt 1989). The data have been collected using various methods, as shown in table 1.

| Goal/ motivation | Method | Data source |
|---|---|---|
| Overview of overall policy and institutional framework | Document studies | On European level:<br>- European commissions website and archive (http://europa.eu.int), in particular its policies related to the Information Society (http://europa.eu.int/information_society)<br>- The website of the Council of the European Union (http://ue.eu.int) as well as the EU's 6th research programme (FP6) (http://www.cordis.lu/ist/)<br>On Norwegian level:<br>- Primarily the government and the ministries, in particular the website of the Ministry of Transport and Communications (http://odin.dep.no/sd), and Post and Telecommunication Authority (http://www.npt.no/) |
| Insights in design and standardization strategies and approaches as well as technical characteristics of the platforms | Document studies | - Trade press in general<br>UMTS:<br>- Primarily the UMTS Forum (http://www.umts-forum.org), 3GPP (http://www.3gpp.org) and UMTS world (http://www.umtsworld.com/)<br>WLAN:<br>- Primarily IEEE (http://grouper.ieee.org/groups/802/11), the Wireless LAN Association (http://www.wlana.org) and Wi-Fi planet (http://www.wi-fiplanet.com) |

Table 1. Primary data sources

| Broad overview of the two platforms | Unstructured interviews | - One interview with a senior researcher from a telecommunication network operator<br>- Two interviews with entrepreneurs from the WLAN industry |
|---|---|---|
| Insights in economic issues, business strategies, markets | Document studies, observations | - Trade press and newspapers, a variety of on-line news<br>- Supplemented by own experiences as users |

Table 1. Primary data sources

Our analysis started by a review of the existing policy documents related to convergence, in particular related to UMTS and WLAN. This provided insights into the governments understanding and anticipation of UMTS and WLAN convergence, the governments' recognition of their own role as an enabler in this process (as well as convergence in general) and the status of the process itself (rollout and implementation of the platforms). To complement these perspectives and direct our further research, three unstructured interviews were held. In particular, they guided us towards a more critical study of the strategies behind the different technologies as well as their technical specificities. From the open ended studies of policy documents and interviews, we turned to focus on a more detailed investigation of the design, standardization and market strategies and approaches as well as the technical characteristics of each of the platforms. The analysis was supported by continuous reflections on our findings and frequent discussions between the two researchers. We also presented preliminary findings and early drafts and received feedback from our own research group, as well as at a Norwegian and a Scandinavian IS conference.

# 2   A Process Framework of Co-Evolution

## 2.1  Theories of Information Infrastructures

Various studies of large, heterogeneous and integrated information systems crossing organizational as well as geographical borders have shown that theories and models found in traditional management and information system literature are not sufficient (Antonelli 1992; Ciborra et al. 2000; Hanseth et al. 1996; Ives and Jarvenpaa 1991; Rolland and Monteiro 2002; Star and Ruhleder 1996). By conceptualizing such systems as information infrastructures we apply a set of analytical tools to our study of how they evolve (e.g.,

Monteiro 1998) and more specifically what factors influence their development trajectories (Strauss 1993). We understand II as a shared resource that is enabling, open and general, evolving, standardized and building on an installed base (e.g., Hanseth 2002; Hanseth 2004).

The notion of information infrastructures was first coined by the Clinton and Gore administration in their political plan to build a nation-wide network and information resource based on the Internet and WWW (see e.g., Branscomb and Kahin 1996; Kahin and Abbate 1995; McGarty 1992). This was followed by the Bangemann report and the European Unions plan to build a pan-European infrastructure that should be the basis for the information society (COM 1994). The IS theory of II has gradually developed by building on different theoretical approaches.

The foundation of an infrastructure is its *installed base*. The installed base is comprised of all existing components of the infrastructure, both technical and non-technical, including technology, standards, and the organizational structures, the practices, behavioural patterns and social preferences of the users (Grindley 1995). The very nature of infrastructures implies that they are never built from scratch, but are rather building on, extending and enhancing existing structures. Thus infrastructures are necessarily evolving and will inherit both the weaknesses and strengths of what already exists. A classical and widely known example of this phenomenon is the design and evolution of keyboard layouts, leading to the development and de facto standardization of QWERTY (David 1985) which is a minor though intrinsic part of the general ICT infrastructure. Due to strong technical interrelatedness, economies of scale and irreversibility, the QWERTY keyboard arrangement has outlasted more optimal arrangement of the keyboard based on the efficiency of typing, such as the Dvorak simplified keyboard (David 1985). Very much decided by temporally remote events, the persistence of QWERTY takes on an essentially historical character.

## 2.2  Different Perspectives on Information Infrastructures

Based on different theoretical approaches, a variety of perspectives on IIs exists. Here, we outline four that have had an impact on recent research in the IS field.

First, IIs can basically be understood as natural *extension of physical infrastructures,* as e.g., "a substructure or underlying foundation; esp., the basic installations and facilities on which the continuance and growth of a community, state, etc. depends as roads, schools, power plants, transportation and

communication systems, etc." (Webster 1979). Following this perspective, we see an information infrastructure as a multi-layered collection of various resources for communication and interchange of data, consisting of hardware, software and services along with the necessary support organization and personnel to develop and maintain it. A fruitful distinction can be made by decomposing infrastructures into subsystems (Hanseth 2002) and into different layers: *support* infrastructures upon which *application* infrastructures are implemented, illustrated by e.g., the basic Internet supporting the WWW applications.

Second, IIs can be seen in *contrast to information systems*. While traditional information systems are characterized by being closed and as having a specific purpose for a limited number of users, the essential aspects of an II are that it is "shared, evolving, open, standardized, heterogeneous and socio-technical construction" (Hanseth 2002, p. 7). An II is by its nature built to serve a wide range of users, user communities and types of applications (Ciborra et al. 2000). An II is thus not an end in itself, it is a mean or facility that helps to achieve something else; it is often viewed as an invisible structure that becomes visible only upon breakdowns (Star and Ruhleder 1996). Lyytinen and Yoo (2002) discuss in particular the challenges for future nomadic information environments departing from convergence. They conceptualize the future II as being: "Technically heterogeneous, geographically dispersed, and institutionally complex without any central coordination mechanism" (Lyytinen and Yoo 2002, p. 379). Thus, the II: "… must be based on a common platform of protocols and data standards to ensure interoperability, stability, reliability and persistence" (Lyytinen and Yoo 2002, p. 379). Although this description is rather technically focused, it nicely captures how the evolution of the II is strongly related to its legacy, i.e. its installed base.

A third perspective is that of *network economics*, in which we understand IIs as evolving according to certain economically explained network effects such as increasing returns, positive feedback, network externalities, path dependency and lock-in (for example Hanseth 2000). Theories of network economics can be used to explain the evolving nature of IIs, in particular in relation to end-users (Hanseth 2002; Hanseth and Monteiro 1998; Shapiro and Varian 1999). Due to heterogeneity and its character of being a network, a successful network evolves by *self-reinforcing mechanisms*. When a network attracts new end-users, the value of being part of the network increases (network externalities), and it becomes even more attractive for other end-users to join the network (Arthur 1994). When the user base reaches a certain threshold, the II as a network will attract new users for enrolment almost by itself. The growth of faxes, cellular phones and the Internet has been used to illus-

trate this pattern of development. However, this base of end-users may also introduce strong conservative forces, in that large numbers of end-users make it difficult to change the network, as for example illustrated by the QWERTY keyboard. As the user-behaviour is not centrally controlled, planned changes in standards or the technical infrastructure should only have small and step-wise effects on the II, as connectivity through compatibility with the existing II is crucial, or users are lost. Further, introducing a completely new network will not attract users as long as old networks provide sufficient services and have a superior number of users, thus the possibilities of introducing new and competing IIs are limited.

Fourthly is the *relational* perspective on IIs. The implementation of an IS will at least from its outset be intended to support certain communities of users while being based on generally accepted practices. As IIs are open systems, they will however also allow for innovation and change, possibly conflicting with existing conventions of use. Such changes may be the result of some shared intentions and efforts among the developers of the II. But it may also happen that the changes are the unintended consequences or unforeseen usages of a new II. This can be illustrated by today's usage of mobile phones and in particular how young people have adopted short message services (SMS) for communication. SMS now comprises an essential infrastructure for communication and interaction between groups of people, although it was not at the outset developed for such usages, and network operators were not pursuing peer-to-peer communication. Star and Ruhleder (1996) point to that: "… infrastructures are fundamentally and always a relation" emphasizing the relational and interdependence between the objects or artefacts and actors and how they mutually shape and reshape the II. Thus, the heterogeneity of the components is not restricted to the diversity of the different artefacts and actors, but also to how the various actors appreciate and interpret the various components related to their perspectives and interests. II will thus be understood differently by different actors' in-action and related to their practices and context. This reveals how choices and politics embedded in such systems become articulated components.

## 2.3  A Relational Perspective on Co-Evolution of Information Infrastructures

We find each of the four perspectives important to describe and understand the multidimensional character of an information infrastructure and the complex dynamics of its evolution trajectory. Although these perspectives are interre-

lated and mutually supporting each other, we in particular find the *relational perspective* as useful to support our discussion of the co-evolution of IIs.

The relational perspective points at the diversity and the heterogeneous character of IIs. At the same time, it also directs our attention to the distinction between the users and the developers, the demand and the supply side of an II. While we have to pay attention to the users and their investments, practices and preferences, as illustrated in the network economics perspective as outlined above, the evolution of IIs will also build on mechanisms related to the strategies, practices and investments of designers and developers of the IIs. For example, in the case of UMTS and WLAN, each of the platforms belongs to separate technological and innovative regimes, with different approaches regarding the diffusion of the innovations, focus on the technology, role of R&D and standardization (Godoe 2000). The various developers will, based on their own history understand the development processes and their implications differently. Even if the individual II are evolving towards integration, their developers will most likely promote their own different interests according to how they believe that specific design choices may support such interests. Accordingly, on the demand side, it is important to emphasize the role of the users, individuals as well as user organizations, as the value of an II is to a large extent defined by its users (Hanseth 2002). In the development of an II, as explained from the network economics perspective, the user may play a conserving role related to changes in practices and preferences, in particular where investments in new network terminals are required.

The analytic distinction between the demand- and supply-side is important. It is however also necessary to realize that one infrastructure may appear differently for distinct user groups, and for these different groups it may not make sense to talk about the same infrastructure (Star and Ruhleder 1996). For example, users installing a WLAN at home will focus on different aspects than when used in an office environment. Further, the actors involved with IIs will not just be either users or developers, but will typically have multiple roles. At the same time, even if the demand- and the supply-side can be conceptualized as different parts of an II, they are closely related. For example, the demand for user terminals (e.g., with multi-media functionality) are highly dependent on the availability of relevant services, and the market for new and advanced terminals depends on the existence of appropriate services.

The socio-technical character of the installed base, including technical and organizational aspects explicitly illustrates its heterogeneity. Heterogeneity further implies a distribution and sharing of the totality (its assets and its value) of the installed base among many different components and actors. Even more important, the power of controlling the installed base is shared

among a range of actors and components: the technology itself, the network operators, the service providers, the innovation and the regulatory regime as well as the users, thus, "nobody is really in charge of infrastructure" (Star 1999, p. 382). Accordingly, the variety and interests of the constituent actors implies that one can only impose incremental changes, limited to only a part of the II, as other parts are controlled by other actors. The trajectory of development will therefore be an ongoing struggle between the various actors with their various incentives, needs and means to bring about change. While the installed base makes IIs difficult to change, the trajectory of change is highly unpredictable and without any central control.

In figure 1 we sketch our theoretical framework of co-evolving infrastructures inspired by a relational perspective. The boxes are meant to describe different perspectives and should therefore be conceptualized as different parts of the II. While the relation between the demand and supply side (vertical axes) represents the most influential factors for the evolution of each II, their co-evolution will include both the interactions between different demand forces as well as supply forces (horizontal axes) as well as across them (diagonal axes). The varying emphasis (thickness) we put on the different relations in the figure are supposed to illustrate the strength of their interdependency. While evolution of the individual infrastructures is illustrated with the vertical axes, the process of co-evolution also involves the horizontal and diagonal axes.

We believe that a relational perspective captures the duality of the demand- and supply-side mechanisms of co-evolution. Where two IIs are evolving
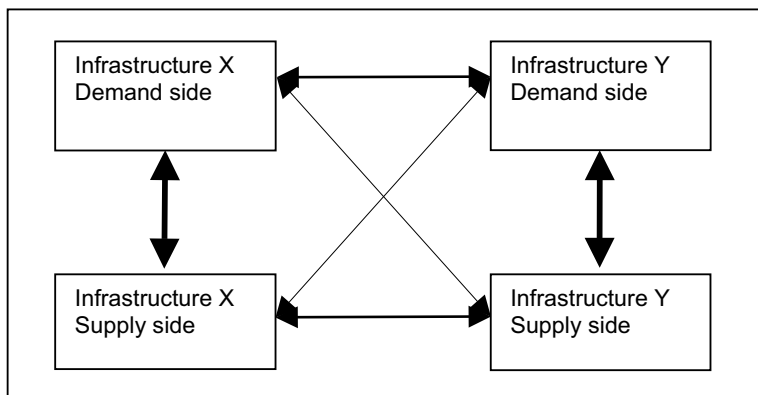


Figure 1. A relational process framework for analyzing co-evolution

under mutual interaction and influence (horizontal and diagonal axes) the process may perhaps end up in convergence. However, as we will show in our discussion of UMTS and WLAN, the tensions between different IIs, based on their inconsistencies and antagonism in interests, strategies and technologies, can be highly influential on whether their co-evolution in fact will lead towards convergence.

# 3   Converging Communication Platforms

In this section we discuss various conceptualizations of convergence. Relating convergence to our infrastructure perspective, we in particular describe convergence as only one possible outcome of co-evolution. We will here limit our discussion to focus on co-evolution on the network level.

## 3.1  Convergence in Visions and Reality

The significance of convergence for the European countries is reflected in European visions and action plans, as for example the European commission's emphasis on the importance of converging communication platforms (e.g., COM 1997, p. ii). More specifically, the 6th Framework Programme (FP6) contributing directly to the realization of the *e*Europe according to the action plans emphasizes the importance of research into, as well as application of converged infrastructures related to ICT platforms:

> These [applications and services for the mobile user] should be based on interoperable mobile, wireless technologies and the convergence of fixed and mobile communication infrastructures. Such applications and services will enable new business models, new ways of working, improved customer relations and government services in any context. (COM 2002b)

The *e*Europe 2002 action plan was primarily focused on spurring growth of the Internet, claiming that one of the biggest assets of Europe was its leadership in mobile communication networks. Convergence was not seen as a primary issue, but the need for a new regulatory framework was identified (COM 2000). The succeeding *e*Europe 2005 action plan builds on its predecessor which is assumed to have: "… reshaped the regulatory environment for communications networks and services and for e-commerce and opened the door to new generations of mobile and multimedia services" (COM 2002a). The *e*Europe 2005 plan further sees convergence as having a major impact on the further development of the Internet and in combination with broadband com-

munication (as for example WLAN) bringing: "social as well as economic benefits"(COM 2002a, p. 8). 3G and interactive digital television is seen as opening up for access to services over multiple platforms, and further: "Technological convergence affords all businesses and citizens new opportunities for access to the Information Society" (COM 2002c).

These visions and strategies reflect the significance attributed to convergence by governments. However, little attention is given to how convergence actually unfolds. Convergence is seen as being driven primarily by technological development, in particular by the digitalization of data and further advances in network infrastructure (e.g., Ono and Aoki 1998). They apparently see convergence as the natural continuation of current processes, although the strategies to some extent draw a complex picture of convergence by including discussions of the differences in regulations and economic factors along with technological factors such as user equipment and services.

At the same time we observe a number of developments not favouring convergence, as for example:

- The lack of (or very slow) integration of mobile phones, hand-held computers and PC's
- The slow diffusion of IP telephony related to tradition telephone services
- The media industry pushing towards copyright reinforcement as digital right management systems (DRMS), hampering the integration of various service platforms
- The building of separate networks for broadcast/multi-media and Internet based broadband, such as establishing a separate Digital Terrestrial Television (DTT) in Norway

While it is possible to argue that this is a result of the lack of coordination among as well as by the initiatives of the various European governments, we argue that these developments are the result of partly technical problems, partly diverging business interest and still separate market forces. The co-evolution of the related networks does not seem to move towards convergence. While the intrinsic limited battery and antenna capacity of mobile phones can explain the lack of more PC-like mobile phones, the introduction of IP-telephony have been challenged both with technical quality constraints as well as regulatory issues. The building of a separate DTT network and the current focus on DRMS are rather motivated by the commercial interests of controlling networks and business models.

## 3.2 The Concept of Convergence

In general, converging means the "*moving toward union or uniformity*" (Merriam-Webster 2003), a concept with many facets and attached meanings. In their work for the EU, the consultancy firm KPMG proposed a more specific definition of convergence: "Convergence is an on-going process which entails the coming together of the following:

- content from the audiovisual and publishing industries;
- potentially separate physical infrastructures (such as those supporting broadcast or telecommunications services) able to carry similar sorts of information at increasingly lower costs;
- the interactivity of information storage and processing capabilities of the computer world; the ubiquity, improving functionality and ease of use of consumer electronics." (COM 1997).

Skogerbø (1997) criticizes this definition for focusing mainly on the technical aspects, neglecting among others the market. She proposes a definition distinguishing between *network*, *service* and *market* convergence. This work has further been extended, distinguishing between four dimensions of convergence (as presented in NMTC 1999):

- *Network Convergence*: Different network platforms provide seamless interconnection and allow for the distribution of any kind of service
- *Terminal convergence*: Equipment may be used to access different network platforms, and/or they may be used for a wide range of services across different platforms
- *Service convergence:* Different services adopt the others format or same services are provided in different formats, e.g., as films, books, or multimedia services
- *Market convergence*: Because of these other kinds of convergence, the actors providing the different platforms and media are becoming intermixed

These definitions provide us with a broad perspective on convergence as it includes several different dimensions. At the same time, however, along with the governmental strategies convergence is still primarily conceptualized as the predefined product. As we have argued, convergence should more appropriately be understood as one possible result of co-evolution. The outcome can at the same time adequately be analyzed and discussed on the different dimensions of networks, terminals, services and markets. Co-evolution will involve all of these dimensions, each of which may evolve at least partly independent

of each other, driven by different interests, agendas, means as well as market-logics. In particular, no single actor will have the sufficient power to execute control across all dimensions.

We argue that our theoretical framework can be useful across these dimensions. However, we find it necessary to limit our discussion to the network dimension in this paper. We understand network convergence as "… *a seamless and interoperable integrated telecommunication and computer infrastructure*" (Messerschmitt 1996, p. 66). The understanding of convergence is itself ambiguous as it can be seen as a continuum; from the ultimate vision of Odlyzko to a more pragmatic view where convergence can be a rather loose interconnection and interchange of services across the platforms. We focus on network convergence in this latter pragmatic view. Framing this definition in our theoretical framework points at three important issues: i) the networks must operate seamlessly together, ii) at the same time the converging networks (as information infrastructures) have to co-evolve from their existing installed bases and accordingly, iii) convergence is not necessarily implying one integrated network. Thus, there may still be two distinct technological platforms in terms of protocols and services.

# 4   UMTS and WLAN as Information Infrastructures

In this section we outline the basic origins of two mobile communication platforms UMTS[3] and WLAN[4] and their installed base both on the demand- and the supply-side. We emphasize their most significant similarities as well as differences. These descriptions underpin our argument that the platforms are both competing and complementary. We further argue that both platforms are developing as radical departures from the underlying business and industry structure they are belonging to, which are their supply-sides, in the sense that new actors are taking part in the value chain and are given the responsibility to develop, maintain and operate certain parts of the network. At the same time, they evolve in conformance with their already existing socio-technical infrastructure on the demand-side of their installed bases.

UMTS is one of several platforms under the IMT-2000 (International Mobile Telecommunications-2000) umbrella making up 3G, the third and next generation of mobile telephony. UMTS primarily enables mobile operators to provide higher bandwidth data services across mobile phone networks. WLAN, here referring to the IEEE 802.11b standard, is a platform designed to extend wired Local Area Networks (LANs), which are networks supporting

the sharing of computing resources. Both these platforms provide wireless access to the Internet and are able to carry any type of digitalized information such as text, graphics, sound, movies etc., and thus basically address the same user needs and market segment. UMTS and WLAN are also both based on radio communication technology, they provide broadband connectivity and they offer a certain degree of personal mobility to their users. However, they are also substantively different in the way they enable the transportation of information, which in particular relates to their distinct origin and the development and implementation of the platforms.

UMTS and WLAN are, or at least intended to become part of general infrastructures for communication and information exchange by being generally accessible, standardized and shared by a large number of users and usages (COM 2002a; 2002b). We thus argue that they both have to comply with the fundamental characteristics of IIs if they are going to succeed as general communication platforms; they must be open, enabling and shared while also evolving, and building on their heterogeneous and existing installed base. More precisely, we emphasize their relations to important actors; as for example the developers of terminals, the service providers and the variety of users groups. Both platforms are already composed of a range of heterogeneous, thus interconnected technical and non-technical elements that all are not necessarily centrally controlled, though the structure of UMTS and WLAN are rather different. UMTS on the one hand is generally vertical integrated resulting from a top-down design strategy. WLAN is based on Internet technology, having a horizontally layered architecture, and being more fragmented based on a bottom-up design approach and further less centrally controlled in design, and in particular in implementation.

When discussing the co-evolution of UMTS and WLAN we have to take into account their two distinct installed bases. Their installed bases include the demand- and supply-side respectively, established and customized user practices and user terminals, as well as approaches to design and implementation and related networks (GSM and Internet respectively). We must not only take into account the internal specifics of the installed base of each platform, but also their interrelationship and the possible tensions between them. A potentially converged and integrated network will have to grow out of the already existing; however different installed base of WLAN and UMTS, and the result will not be a discontinuity in relation to these predecessors.

## 4.1  UMTS: Ubiquitous Access, *de jure* Standardized and Centralized Implementation

UMTS is to be developed and deployed European-wide by mobile network operators and is developed within the framework of the telecommunication sector. UMTS services shall be offered to end-users (mobile phone subscribers) on the basis of subscriptions similar to the current GSM networks. The basic business model is based on mobile network operators owning and operating the infrastructure on a national basis, interconnected nationally as well as globally with wired PSTN (Public Switched Telecommunications Network) as well as other UMTS and GSM networks. The design and operation is thus centralized and managed top-down, while the services are vertically integrated. As centralized, coordinated and vertically integrated networks, UMTS inherits the basic services from the GSM networks such as *authentication, authorization and accounting* (so called AAA-services[5]). The key feature of UMTS from the subscriber-perspective is continuous Internet access with relatively high bandwidth compared to GSM. This enables a range of new services and marks a turn from a focus on voice to data services. Access to the services is provided by a network of interconnected base stations intricately arranged on the basis of the number of subscribers and their patterns of usage. One key cost issue for UMTS is that increasing the bandwidth requires a higher density of base stations as compared to the existing GSM network. Even if the platforms theoretically can support data rates up to 2 Mbps, the real rates are rather expected to be close to 100 kbps (Lehr and McKnight 2003), depending on usage patterns and the density of base stations.

The work on the UTMS platform started in the 1980s by the International Telecommunication Union (ITU). The ITU initiative resulted in the global IMT-2000 standard later adopted by the European Telecommunications Standards Institute (ETSI) in 1991. Already in 1992, frequencies for UMTS were allocated on a world basis at the World Radio Conference in Malaga (WRC-92). In 1995, the UMTS Task Force (SMG5) was established within the ETSI, officially recognized as a standardization organization by the European Commission. ETSI was a founding partner of 3GPP, which was created in December 1998 after pressure from ITU to coordinate the various 3G initiatives globally under the IMT-2000 umbrella.

UMTS has had much attention by the European Union as well as the Norwegian government (see e.g., COM 1997; COM 2002a). The platform is seen as a key for the further development of eEurope, and selected as the *de jure* standard by the European Parliament and the Council in December 1998:

> Member States must take all actions necessary in order to allow the coordi-
> nated and progressive introduction of UMTS services on their territory by 1
> January 2002 at the latest and in particular must establish an authorization sys-
> tem for UMTS by no later than 1 January 2000. (COM 1998)

In the case of Norway, four actors were granted licenses based on this decision to implement and operate UMTS networks in Norway. These were allocated based on a license competition or as a beauty contest[6]. The license fees for UMTS have been substantial, at least seen in relation to the so far lack of revenues for the licensees. The size of the fees has also had far-reaching consequences for those bidding on and buying them[7]. In late 2001, one of the actors in Norway went bankrupt resulting in the withdrawal of their license, while another actor later returned the license. The two vacant licenses were auctioned again during the summer of 2003, and the only new bidder for this license is one of the current three licensees. This reflects the limited interest in the market that can at least partly be attributed to the late freezing point of the standard and the resulting delays in network equipment and end-user devices. According to the licensees they are however on track related to the implementation of the infrastructure and the networks (one of them covering 1.7 million people). However, due to lack of sufficient user terminals available (in terms of brands and quality), lack of services as well as varying quality in the test-networks, the first commercial network in Norway was launched as late as December 2004.

The introduction of UMTS networks in Norway are based on a *revolutionary* approach, implying the building of new, monolithic, nation-wide networks, necessarily in competition and possibly cannibalizing existing GSM-traffic and -networks. This approach is at least partly a result of the standardization approach. With the centralized and top-down manner approach adopted by ETSI and 3GPP, network operators as well as manufacturers will have to wait until the standard is somehow stabilized in line with earlier standardization approaches (e.g., NMT and GSM). Even if the standard is strongly supported by governments, the willingness of the operators to implement operational as well as test networks has been limited, in particular due to the lack of return on investments. Another important factor behind the revolutionary approach is the UMTS licenses not accepting licensees to share network infrastructure (in particular in rural areas), but dictate the UMTS networks to appear as independent (NMTC 2000; 2002; 2003). The primary argument for these regulations was to secure real competition as well as to reduce the vulnerability of having only one network. Due to delays in the rollout of the UMTS network, however, suggestions have been made from a range of actors, in particular the network operators, as well as the authorities to allow for coop-

eration. This is primarily related to national roaming, in particular in sparsely populated areas. However, no decision has yet been taken. Somehow lessening the pressure on the licensees, they have been allowed to delay their roll-out schedule for up to 15 additional months.

Even if one of the licensees launched their UMTS network commercially 1st December 2004, there are few if any new services (related to old GSM services) available, the network only covers half the populated areas of Norway and only one (high-end) phone is available and supports roaming between the GSM and the UMTS network. Thus, the platform still has to show its appropriateness for more than making phone calls. It seems that the different stakeholders related to UMTS are still in some kind of a dead-lock, since operators have been waiting for services and handsets, service providers for operational networks and appropriate end-user equipment, while the end-users for all of it, and so forth. The problem that UMTS faces in entering the market is also amplified by the fact that enhancements of 2G networks such as GPRS[8] and EDGE[9] have provided a number of the services that were thought to be the killer application for UMTS, such as for example Multi Media Services (MMS).

## 4.2  WLAN: Semi Mobile Access, *de facto* Standardized and Decentralized Implementation

WLAN has grown out of the computer industry as an extension of LANs (local area networks), and is implemented by a range of different actors, such as private persons, corporations and so called *Wireless Internet Service Providers* (WISP). The key feature of WLAN from the user perspective is providing wireless, mobile high-bandwidth data communication facilities and LAN access within a limited geographical area. Even if roaming between networks is possible, WLAN is usually implemented as distinct networks, typically only available within a home, a building or a campus, providing no seamless interoperability between these locations. The different WLAN standards operate on a license-exempt frequency band, allowing everybody to set up a local WLAN network without a license and thus without any additional costs.

WLAN entered the business environment in the early 1990s. In 1997, IEEE introduced 802.11 as a part of the 802 LAN families of standards, with the aim to ensure interoperability between equipment vendors as to secure the growth in the WLAN market. In this way, WLAN and LAN offer the same interface upwards to the network layer (typically IP), which is in accordance with the

Internet network architecture. In 1999, the 802.11 standard was amended to increase the performance (speed) with 802.11b providing 11 Mbps. Today, the most frequently used 802.11b standard is also accompanied with 802.11a, and 802.11g, providing respectively more secure connections and higher bandwidth.

WLAN implementations are basically based on the installation of one or more base stations (so called access points) that are connected to a wired LAN. In addition, each user device must be equipped with an appropriate WLAN card, being configured for this specific access point. Within the reach of the access point (normally about 50 meters) the network is accessible, which reduces the need for wiring office areas as well as private homes. The common business model for equipment producers is to sell this equipment to companies and the consumer market. WLAN connectivity and usage is commonly provided free of charge (in the case of the home), even if usually restricted to a certain user group (in the case of a campus or a company). Lately, however, WISPs provide Internet access in public areas (so called hot spots), typically in airport lounges, restaurants or hotels, for a smaller or larger fee. While being attractive regarding bandwidth speed and ease of installation, local implementations of WLAN have suffered from much negative attention in the media regarding its lack of security services compared to that of a wired LAN, enabling attackers to monitor and tap the networks for non-encrypted information. These challenges, however, have become visible as a result of experiences and changes in usages over time.

The current de facto WLAN standard IEEE 802.11b does not include AAA-services (see 4.1). Thus, each WLAN implementation has to implement its own regime. This include hotspots which must implement payment services, implying rather complicated and time consuming registration and access routines for the user, in particular if accessing different networks with their idiosyncratic access and billing regimes. This is however the nature of a standard designed to offer wireless access as an extension of existing LANs i.e. that is horizontally integrated. At the same time, the success of public WLAN (provided by WISPs) is dependent on the provision of seamless connection between different local WLAN networks without the user having to enter new registration information every time he switches to an access point connected to a different network. Rendering this possible will require the establishment of contractual agreements between the WLAN providers to be able to offer seamless discrete mobility and roaming between the independent hotspots (e.g., agreeing upon business models and billing policy).

The standardization process of WLAN and the implementation of the networks have been open and out of central control, resulting in competing stand-

ards and proprietary services, as for example a variety of security and billing solutions implemented by WISPs. This competition is still going on, in parallel with the operation of existing networks.

## 4.3  The Role of the Installed Base in the Evolution of UMTS and WLAN

As a basis for our further discussion of co-evolution and the various mechanisms of the installed base of UMTS and WLAN, table 2 briefly summarizes their primary properties and highlights the difference between them according to the framework described in figure 1 in section 2. We argue that these differences, both on the demand- and the supply-side will strongly influence their future evolution and thereby also their future interrelationship.

In general, the platforms are strongly interrelated with their predecessors, respectively GSM and LAN. In the case of UMTS, the physical network including base stations and network management hardware and software has to be built from scratch, and in that respect will not be built on any existing network. However, UMTS operators will most likely utilize part of the existing installed bases of their infrastructure, as for example systems for accounting and customer management etc., as well as roaming with the existing GSM network in rural areas and interconnection with the fixed phone network. This installed base will of course be a valuable asset concerning the existing operators, however possibly bringing barriers for entrants in the market without such networks.

The case of WLAN is quite different, as it has grown out of the data communication world, dominated by small and mostly independent networks and network providers. The WLAN network is comprised of a large number of small networks, developed and implemented in an uncoordinated manner. At the same time, they have one important part of the installed base in common, the backbone Internet. This implies that their installed base includes the service providers as well as the services and existing Internets users. The use of WLAN has developed over time, and in conjunction with the Internet. As the current WLAN (IEEE 802.11b) standard has become a de facto, the installed base of existing implementations requires backward compatibility for new and enhanced standards (as with for example IEEE 802.11a or IEEE 802.11g).

| Dimension | UMTS | WLAN |
|---|---|---|
| *Demand-side* | | |
| User base | Subscribers from GSM and contents service providers | All PC users and existing Internet service providers |
| User needs | Largely unknown, usage frowing out of 2G | High bandwidth and semi-mobile access to Internet |
| *Supply-side* | | |
| General architecture | Verticallly integrated, network operator-based approach | Horizontal integrated, end-user centric decentralized approach to service provision |
| Technological base | Interconnected with 2G | Extends Internet/WLAN |
| Development approach | Comprehensive, top-down oriented and specification-driven formal standardization by ETSI/ISO | Layered, incremental, bottom-up, IP/TCP-compatible *de facto* standardization |
| Physical/ technical characteristics | Coordinated network of base station aiming at national coverage providing seamless roaming | Distinct, uncoordinated access points connection to Internet. Roaming between different networks not provided by standard |
| Security | Extensive security including authentication and authorization | Limited security functionality in standard |
| Billing/ accounting services | Interconnected with existing billing/accounting services from 2G/ wired phones | Idiosyncratic and uncoordinated billing regimes across networks |
| Implementation strategy | Revolutionary, centrally controlled | Incremental, partly decentralized, evolutionary |

Table 2. Key factors of installed bases important in the co-evolution of WLAN and UMTS

## 4.4  The Parallel Evolution of UMTS and WLAN

WLAN and UMTS have been growing as individual platforms and out of distinct industries, but their evolution has at the same time been mutually influential. Their interaction can be characterized both complementary and as
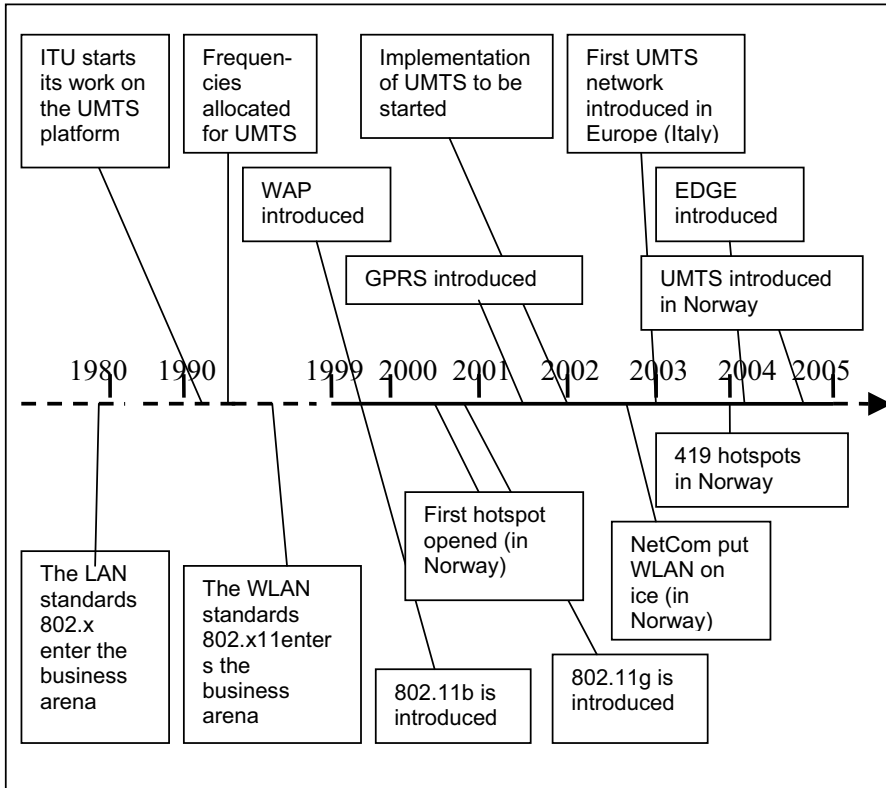
Figure 2. Milestones in the evolution of UMTS and WLAN

competing. Figure 2 highlights important milestones in the evolution of UMTS and WLAN.

Below, we provide some illustrations of the mutual influence in the co-evolution of WLAN and UMTS related to the platforms themselves, the user equipment and the strategies of the various actors.

The penetration of mobile phones in Norway is 96 percent[10] and more than two million mobile phones were sold in 2004 (to a population of 4.6 million citizens). Furthermore, there is a current trend where people are migrating from fixed phones to mobile phones, i.e. they no longer have a fixed line phone at home. At the same time, more than 60 percent of the households have Internet access, and most PC's and laptops come with WLAN capabilities. Through an increasing number of private WLAN's, consumers are provided with high bandwidth access to the Internet in a semi-mobile way. In parallel,

GSM subscribers (and gradually UMTS in the future) are provided reliable, secure and ubiquitous network access, however primarily used for voice and SMS services. As an increasing number of users have access to and use WLAN and UMTS there will also be an increasing need for interoperability. However, the users' experience with the characteristics of the respective platforms is very different, in particular when it comes to bandwidth and network accessibility along with pricing policies. While the further development of WLAN from a user' perspective will be related to additional enhancement of bandwidth, the interest in UMTS will foremost be related to the provision of content services and pricing structures. These developments seem to have strengthened rather than weakened the separation of the platforms, as the users' experiences and practices are constantly confronted. However, this calls for novel strategic thinking and innovations that may lead towards greater interoperability.

The attempt from the network operators to provide information services and access to Internet with WAP[11] was more or less a failure. In parallel, WLAN, which was originally designed as an extension to LANs in the office environment, successfully moved into hotels, cafes, airports and homes, even tough this occurred in a decentralized and unplanned manner. The success of WLAN outside the office environment can at least partly be attributed to the lack of adequate Internet access through GSM (WAP) and the delays of UMTS. In response to the delays of UMTS and probably also the success of WLAN, the bandwidth of the GSM networks have been extended with GPRS (2001) and recently EDGE (late 2004). Based on different efforts to capture the mobile Internet market, these processes show how the different actors and their respective platforms (GSM with WAP, GPRS and EDGE, UMTS and WLAN) have mutually influenced each others in rather unforeseen ways, illustrating the dynamics of their co-evolution.

According to the Norwegian Post and Telecommunication Authority the number of WLAN hotspots was reduced from 518 in 2003 to 419 in 2004. After two years with WLAN on ice, one of the network operators (NetCom GSM) announced further developments and expansion of their network of hotspots in November 2004. Currently, the largest WISPs (and thus providers of hotspots) are the telecommunication network operators. Network operators do obviously have an ambivalent relationship to investments in WLAN as long as there is a risk of cannibalization, in this case related to GSM and UMTS. Their position as the largest actor in the hotspot market does show that they find the platform of strategic importance. The delays in their implementation strategy do, however, indicate that the future developments are rather uncertain. When planning for further expansion of WLAN, they have to take

into account their installed base of GSM technology and users, and vice versa. Having a strong market position related to GSM and UMTS, network operators will necessarily act cautiously to not make users migrate to other platforms, out of their own control. Thus, with their strategic position, network operators do have a key role in the further co-evolution of WLAN and UMTS.

# 5 WLAN and UMTS as Co-Evolving Information infrastructures

According to our previous discussions, and deriving from theories of information infrastructures, the future evolution of both UMTS and WLAN will be strongly influenced by the characteristics of their respective installed bases. As discussed in chapter 4, a possible co-evolution of these platforms towards convergence, by which we mean seamless interoperability, may not imply one integrated network and there may still be two distinct technological platforms in terms of protocols and services. At the same time, we argue that their co-evolution necessarily will involve coordination at both the demand- and the supply-side, and include a range of different factors, as illustrated in table 2. We start the next section by discussing the further evolution of the platforms, followed by a discussion on whether convergence is a likely outcome of these processes.

## 5.1 What Will Drive the Evolution – The Users or the Suppliers?

The demand and supply sides of the installed bases of each of the platforms are not independent; the relations between the suppliers and users imply that they are mutually influencing each other and changing over time. For example, user preferences and practices do strongly impact design choices and the possibilities to implement such changes, and at the same time, the user habits are changed through the marketing efforts by the developers. The nature of and the strength of these installed bases (for example the importance of backward compatibility, the significance of existing user practices, etc) will influence the platform's ability to accommodate changes. At the same time, being both competing and complementary platforms, their co-evolution will be linked to both the demand- and the supply-side of each of the platforms (the vertical axes in figure 1) as well as their mutual influence (the diagonal axes).

A successful implementation of UMTS networks will heavily depend on the type of business models that are applied, i.e. the revenue sharing between network operators and third party service and content providers, as illustrated below. To implement such systems is not primarily a technical challenge, and a variety of business strategies from the different network operators are likely to be developed as extensions to vertically integrated and detached networks. Even if networks become interconnected, the question that still remains open is whether the network operators will approach the users, both service providers and subscribers with specialized and exclusive services to obtain a competitive advantage. For example, NTT DoCoMo has implemented an exclusive service offer with i-mode (providing services such as email, weather information, news and entertainment for mobile phones) in Japan (e.g., Funk 2001). Alternatively, network operators can provide open and public access to such services across the networks, as for example the loosely interconnected implementations of CPA-platforms by the GSM network operators in the Norway (Nielsen and Herstad 2004). These different business models are in both cases dictated by the network operators.

To introduce new products or services in an open market is a demanding challenge. In the case of UMTS it may for example take several years before investments will be recollected. In spite of having promised to open the UMTS network, the telecommunication operators have instead been enhancing their already existing networks with new services such as GPRS and EDGE. Thus, UMTS network operators will have to provide attractive services in order to persuade subscribers to upgrade from GSM/GPRS to UMTS handsets. The content service providers must at the same time be attracted towards UMTS, which depends on whether the business models from GSM will be adopted with UMTS. However, this is not only in the hands of the telecommunication operators, but much depends on the manufacturers of user equipment, as well as the service providers. The heritage of the installed base thus has ambiguous effects; delaying the implementation and use of UMTS on a short term basis, while possibly driving it in the longer term.

While commercially available UMTS networks and handsets are just in their infancy, WLAN implementations have been flourishing for a while. The WLAN standard has evolved to accommodate the emerging user practices as well as security breaches, even if the heterogeneity of users, usages and additional services makes upgrades to new standards challenging. Since the networks are not centrally coordinated, all changes must be backward compatible. For the users, possible changes in hardware and software may not be seen as necessary or appropriate as long as the local configuration provides a satisfactory (wireless) extension of the LAN. This end-user-oriented, decen-

tralized approach has created highly successful local implementations, but has also resulted in distinct and uncoordinated networks, in particular related to billing regimes and roaming. Furthermore, a variety of business models also exist. For example, some restaurants provide WLAN access for free, while many hotels charge their guests for their facilities. This may in particular act as a barrier for users with cumbersome registration processes whenever they have to roam from one network to the other. Some WISPs (in particular the network operators) have tried to implement a range of hotspots as to pursue economies of scale and capture a larger share of the market, but they have not managed to cover a significant portion of Norway, and one single WISP has not turned out to be the market leader. It does not seem that one, coherent strategy will dominate the WLAN evolution.

## 5.2 The Further Co-Evolution of WLAN and UMTS - As Converging or Diverging Platforms?

A co-evolution of UMTS and WLAN that results in seamless interoperability or at least facilitate roaming across the platforms, implies harmonization and coordinated development of functions and services at the transport-, service- and application layers. Currently, we do not see full integration at the transport layer as a realistic option, as user requirements of the two platforms; their utilization of frequencies and their regulatory environment are far from consistent. However, gateway solutions may provide acceptable interlinking and roaming capabilities between the platforms (Messerschmitt 1996). On the regulatory level, the recent Norwegian Telecommunications Act of July 2003 suggests common terms for any digital transportation network, but it remains to be seen what the consequences of this will be. Furthermore, we see several obstacles related to smooth interoperability, e.g., related to security, billing and other administrative matters.

A possible co-evolution towards greater interoperability thus implies that actors previously independent of each other now will have to interact. This may be particularly difficult in the case of WLAN were many different and independent actors, both providers and users of communication services do not have institutions to support the coordination of common problems related to issues such as interoperability. Having rather different views on the world (Neumann and Star 1996), the different actors will most likely view the process of co-evolution and its results differently, and act strategically to protect their own interests. As illustrated in 3.1, such different interests may rather benefit from maintaining the existing separation of the networks. In particular, network operators with their strong market position (e.g., the duopoly situa-

tion in Norway related to GSM) will be reluctant to support interoperability if it implies that they will lose their control over important assets such as their user base and strategic position in the value chain.

Providing extensions to local area networks, the installed base of WLAN networks has developed rather uncoordinated over time. Gradually changes that also include facilities for interconnection to UMTS networks may be feasible, but this is only likely if driven by changing user requirements. Since local implementation of WLAN in this respect will be open to local adaptations and out of any central control, this may be difficult to achieve. While telecommunication operators are used to coordinated, big-bang type implementations of networks (as in the case of GSM), changing all the WLAN networks will require a more evolutionary and step-wise approach and will be much more difficult to achieve.

While vertical integration will discourage diversity of applications, horizontal integration will encourage this diversity (Messerschmitt 1996). Being based on horizontal integration, WLAN eases the entry for application developers. On the contrary, telecommunication network operators have historically favoured vertical integration, and this approach may again be favoured, along with it proprietary solutions and exclusive services for the different UMTS networks. However, the existing GSM network operators are facing stagnation as their traditional markets become saturated (for example Vincent 2001) and will have to seek new areas and support to increase network traffic. Providing open interfaces for third party developers is obviously one such approach. Messerschmitt argues that such powerful economic and technological forces are driving towards horizontal integration (Messerschmitt 1996). On what terms such developments will unfold and how to solve the fundamental incompatibility between vertical and horizontally integrated platforms, however, are still open issues. One scenario could be that telecommunication operators open their UMTS networks and for example detangle the so called AAA-services from the transportation services. Another alternative could be that WLAN are being utilized as a UMTS carrier enabled by additional AAA-services provided by telecommunication network operators. At the same time, we only find telecommunication operators to have the power and the potential to create a uniform move towards integrating these networks. Even if the telecommunication operators may initiate work to include AAA-type service interfaces in their networks in order to integrate WLAN networks, it is not likely that a corresponding interface will be available in all the various WLAN implementations, and unanimously for subscribers regardless of the operators. At the same time, the telecommunication network operators' control of UMTS as well as WLAN is limited to the supply side. The authorities are also closely

monitoring them to avoid a continuation and extension of the current duopoly in Norway.

We have argued that the two platforms are evolving through a complex interplay between various actors, among them the designers of standards, the product developers, the service providers and the different user groups along with the organizational and institutional context they are growing out from and into. Efforts to stimulate a distinct trajectory will therefore be intrinsically challenging, since no one is really in control of any II and the process is not linear from specification to construction and implementation (e.g., Ciborra 2000).

# 6 Conclusion

In this paper we have introduced a theoretical process framework of co-evolution, drawing upon a relational perspective on IIs and their installed bases. Based on this framework, our case description and discussions are aiming at illustrating the multi-dimensional character of the factors that influence the evolution of communication platforms. To understand their separate evolution as well as their interrelated co-evolution we have to move beyond a simple network perspective and include issues as e.g., roaming, security, accounting and billing. Thus, even if available gateways between the platforms provide seamless interconnection, they do not necessarily fulfil the requirements from the users or from the network operators and service providers to become successful.

In the case of UMTS, it has its roots in monopolistic organizations, accustomed with centrally controlled development and revolutionary implementation strategies – which is in contrast to the computer industrial tradition that WLAN has grown from: Small, competing companies, bottom-up approaches and independent networks. While implementing UMTS as vertically integrated sets of well-defined functions and services, WLAN implementations resemble the horizontal integration of compatible function and services, but also lack important facilities such as roaming, authentication, authorization and accounting. We claim that even if the UMTS network operators may initiate work to include interfaces for such services in order to integrate WLAN networks, it is not likely that corresponding interfaces will be available in the various WLAN implementations within a short time frame. Interoperability will imply coordinating activities on a number of issues, which we believe will require negotiations between various actors related to different and conflicting needs and agendas. In addition, some issues will only become apparent when

UMTS implementations are readily available, as usages will develop over time. However, this may not hamper seamless interoperability as a possible result, as incremental and experimental development approaches may very well be the best (and only acceptable) strategy.

A possible final convergence of communication platforms will have to include a range of dimensions (such as network, terminal, service and market), with different platforms integrated into one common II, serving common markets with common services accessed by common terminals. We therefore underline the need for an adequate understanding of the IIs involved in co-evolution, including the demand- as well as the supply-side of the installed bases and their intra- and interlinkages, to capture the possible trajectories of co-evolution. By focusing on the installed base we have drawn the attention to the inherent and conserving parts of the II related to investments in technology, organizational structures, understanding of design and implementation as well as user preferences and practices.

We argue that co-evolution provides an appropriate framework to study how interrelated information infrastructures evolve by providing a perspective where the process of co-evolution is analytically open for many different trajectories, some towards convergence while others may have a more diverging character.

# Notes

1. Co-evolution was first used in biology to describe exertion of mutual selective pressure between different species in their evolution. It have also been applied in science and technology studies, for an overview see (Geels 2004).
2. Interestingly, the very first provision of WLAN outside a traditional LAN environment (a so called hotspot) was at Park Hotel Halden (August 2000) situated in the small city Halden south of Oslo, Norway.
3. For more information see for example http://www.umts-forum.org and http://www.imt-2000.org/portal/index.asp.
4. For more information see for example http://www.wi-fi.org.
5. A service is understood as a functionality that is generic, or common to many applications, as, e.g., data transportation, while an application as a collection of functionality of value to an end-user.
6. An alternative selection strategy in other European countries has been auctions, where the highest bids have been the criteria for selecting among the candidates.
7. German licensees have paid approx. 50 billion €, correspondingly 38 billion € in the UK.

8. General Packet Radio Service (GPRS) is an enhancement of GSM providing up to approx 115 kbit/s of bandwidth.
9. Enhanced Data for Global Evolution (EDGE) is a more advanced enhancement of GSM, providing up to 384 kbit/s.
10. Telecom statistics, Half-year 2004, Norwegian Post and Telecommunication Authority.
11. WAP - Wireless Access Protocol, allowing for efficient transmission of optimized Internet content to mobile phones.

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APPENDIX IV


Steinar Kristoffersen, Petter Nielsen, Ole Hanseth and Jennifer Blechar

"Ordinary Innovation" in Nomadic and Ubiquitous Computing: the Need for Alternative Theories in an Emergent Industry.

In Sørensen, C. Yoo, Y. Lyytinen K. and J.I. DeGross (eds). *Proceedings of the IFIP 8.2 Working Conference: Designing Ubiquitous Information Environments: Socio-Technical Issues and Challenges*, Cleveland, Ohio, 1-3 August, 2005.

# 'ORDINARY INNOVATION' OF MOBILE SERVICES

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Abstract:     The anabolic growth of 'dot.com' — with 3G network license auctions as the grand finale — implied a series of large investments in mobile technology. Without new products and services utilizing this infrastructure (m-services), however, these investments may never be recollected, and today there is no sure sign of demand for these new "nomadic applications" in the market. This paper shows how actors in the m-services value network co-ordinate their efforts to bring such applications to the marketplace. It shows their risk averse and locally optimizing strategies, which theoretically is very different from the current fascination in IS with *disruptive* innovation. This paper illustrates the need for a theory of 'ordinary innovation' in nomadic and ubiquitous computing.

## 1.      INTRODUCTION

The adoption of mobile services seems to be fading in the Scandinavian countries. This is not due to a lack of interest for mobile devices, however. Although some markets are almost completely saturated with respect to mobile phones (96% ownership in Norway[1]), there is still growth in hardware sales. For example, Norway and Sweden, currently among the most mature markets in this respect, saw a 25% increase in sales last year alone.

Network traffic is also increasing, with Sweden, Norway and Denmark showing a 10−20% growth in mobile-originated voice traffic time. However,

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[1] First half year 2004, Norwegian Postal and Telecommunication authority

the operators' revenue in Sweden e.g., decreased by 2%[2], probably due to increased competition. According to analysts, new services will be required in order to secure growth and justify investments in next generation mobile telephony[3] (Vincent 2001).

Next generation mobile telephony is very much a product of the expansive business conjunctures towards the end of the nineties[4]. This period was characterized by its orientation towards radical innovation and technologies (typically internet-based), which would (it was claimed) radically change the industrial landscape which they entered[5]. For instance, one of the companies which we are currently studying was at one point devoted to developing "a revolutionary system that provides the user with easily understandable travel assistance before and during a journey."  Its ambitions included:

• Stunning use of 2D and 3D
• Cutting-edge technology and methodology
• Unique visualization
• Multi-resolution image representation
• Etc.

This type of rhetoric was not conflated by the burst of the 'dot.com bubble', however. The aim of most projects back then would be to create radically new functionally on top an infrastructure (the Internet) which had taken on almost mythological proportions, and of which it was though no-one could really envisage even, its limitations. This line of attack it seems, in many contexts, has become reified as the definition of 'innovation' as such. Indeed, many programs offering innovation studies and training in entrepreneurship is preoccupied with the idea of a start-up, unique ideas and the hard work of a dedicated, enthusiastic team[6].

Within academia as well and perhaps most coherently building on the framework of disruptive innovation as proposed by Christensen (1997), there has been lot of interest for this category of innovative processes.  In this perspective, *disruptive* technologies are described as creating entirely new markets through new technology. This technology might initially be underperforming compared to *sustaining* technologies which are meeting the needs of the biggest, most profitable customers. However, it serves the need of a fringe segment of customers who would otherwise not be able to enjoy

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[2] http://www.digi.no/php/art.php?id=114473

[3] http://www.digi.no/php/art.php?id=113043

[4] http://wirelessreview.com/mag/wireless_grief_dotcom_era/

[5] Insofar as we know, there have not been any systematic studies of the dot.com rhetoric as such. However, many good examples exist, cf. http://www.funkybusiness.com/funky/

[6] http://www.grunderskolen.no, e.g., or at http://www.hbs.edu/entrepreneurship/bplan/findteam.html where the business plan contest is a particularly good illustration

this functionality (in might, e.g., simply be cheaper or offer less mainstream, but still critical functionality for some). When technology development catches up with customer requirements (and, simplistically, "Moore's law" implicates that it will) then it is too late for the incumbent to become competitive: The industrial landscape has changed.

In some of this literature, not only does it become apparent that disruptive innovation is a laudable objective, inasmuch as the alternative outcome is 'extinction' (Christensen 1997), but it is also one for normative or at least methodological steps can be taken (Christensen and Overdorf 2000; Cosier and Hughes 2001; Kostoff et al. 2004; Thomond et al. 2003).

Although we are not, in this paper, going to argue strongly against the perspective outlined above, we wish to present an empirical framework that as a supplement can help us better understand, on a more detailed level, the transformation in the telecommunications market as they unfold; over time as well as on a day-to-day basis.

Currently, mobile services show modest uptake and high price sensitivity. However, such services are embedded in a complex and not completely open infrastructure; there is fundamentally a high threshold for content providers wanting to come out into the marketplace with new services. They need access agreements with operators, they need a mechanism for billing and the medium itself is not sufficiently omnipresent for it to be useful as a marketing platform; content providers have to market their products in other (and more expensive channels) such as magazines in order for consumers to become aware of the services. Additionally, consumers are still quite demanding and competition is tough. For service providers and developers, therefore, the risk is high. This is a situation in which actors have to coordinate their work finely and with a perspective of reducing risk, or they might end up in bankruptcy.

One of the biggest challenges in this emerging industry is to develop efficient and reasonable "value chains". Making and managing value chains can be seen as coordinating business models and practices. Therefore, this paper will explore the ways in which coordination, which we find of primary importance, takes place between actors in the mobile service network in Norway. Three case studies, representing a content provider, a content aggregator and the network operators will be presented and discussed.

The next section of this paper will briefly discuss existing theories used in the mobile telecommunications arena. This will be followed by an overview of the three cases. The results of the case studies will then be presented through the discussion followed by the conclusion.

## 2.       RELATED RESEARCH

There have been quite a few studies carried out on 'm-business' from various perspectives over the last several years. Telecommunications was (and is) an integral component of the promise of exponential growth of industrial activity and wealth that was made by the 'new economy'. Clearly, these promises were overly optimistic, but even though developments in this sector have fallen somewhat short of expectations, we are still witnessing a tremendous technological advancement in wireless networks and mobile technologies. Thus, this area has been faced with renewed interest in the research field.

Some of this recent research is oriented towards analyzing industrial developments in the telecommunications industry and the emerging business relationships on a macro-level. For example, Lyytinen and King describe an innovation framework for the wireless industry (Lyytinen and King 2002). Their model of the *innovation system*, the *market* and the *regulatory regime* has been adopted in studies of the mobile arena in different regions (cf. Yang, Yoo et al. 2003; Fomin, Gao et al. 2004). Although this model is useful in pointing to essential interactions and relationships, we found in our cases, an opportunity of going into some of the same aspects on a much more detailed, observable level.

There has been other work carried out within the same general tradition, but at a lower level of detail. For instance, Camponovo and Pigneur (2002) and others (cf. Mylonopoulos, Sideris et al. 2002) focus specifically on an exploration of the various actors involved in the m-business arena to provide insight into changing roles and relationships in this market. While work such as this has been useful to provide general guidance to the structure and composition of the mobile services arena, most contributions are primarily conceptual, rather than empirical. We believe that empirical contributions are warranted as well, and that they are indeed a necessary prelude to developing a coherent theory of this emerging domain.

## 3.       MOBILE SERVICES IN NORWAY

We will now turn to our cases: The Norwegian mobile network operators' (NetCom and Telenor) *CPA* (Content Provider Access) platform, *MultimediaContent.com*'s[7] mobile content distribution and *mPay's* mobile payment solution. Briefly, the CPA is a set of services that gives content providers    access    to    the    SMSC[8]-based    infrastructure    of    the

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[7] Names have been changed for anonymity
[8] Short Message Service Centre

telecommunications network, as well as the billing services that make it possible (in a cost-effectiveness perspective, at least) to charge users for low-cost services. MultimediaContent.com is a content aggregator. Primarily, the services that they provide are:

- Managing suites of content (games, ring tones, logos) for mobile portals,
- Marketing towards end-users as well as operators, and
- Testing content for various handsets.

mPay is both a content provider and a payment solution, providing a content service allowing users to pay for parking using their mobile phones and (in the future) a mobile payment solution service to content owners/aggregators. A simple view of our cases, then, is that they include a content provider (mPay), a content aggregator (MultimediaContent.com) and the operators (Telenor and NetCom).

Data was collected from our cases through a variety of qualitative methods. Related to the implementation and operation of CPA, a total of 39 formal interviews were conducted with managers, designers and system developers in a total of 23 different organizations. Interviews were recorded and fully transcribed and included the network operators as well as the largest aggregators and content providers. The field site selected was thus not one organization, but rather a business sector with a range of actors which together provide the necessary resources, competencies and components to make up the platform. For the mPay case several in-depth interviews were conducted with the founder and other employee in the organization. These were recorded and semi-transcribed. Other informal discussions also took place and the data presented in this paper related to this case was reviewed and confirmed by the founder of the organization. For MultimediaContent.com data was collected in semi-structured interviews with three managers, plus document studies facilitated by a project database covering the period from 1999 up to present activities.

The technical infrastructure upon which this value chain is configured is SMS-based. Customer request content using SMS, and receive (to their handset) a SMS or a push-WAP message. The handset deals with the message either by displaying content directly, or fetching it across GPRS from a URL embedded in the message. The crux(es) of the wider business infrastructure will have to be found at the interplay and coordination of and between such actors, and we will present that next.

## 3.1    The CPA-platform

In 1997, the two Norwegian mobile phone network operators (NetCom and Telenor) launched platforms for exclusive content and utility-based SMS services for their respective mobile subscribers. Both attempts did,

however, suffer from only being a part of a "value adding services" offering and thus receiving limited internal resources both for investments in technology as well as investing in content. While these platforms generated very limited traffic, the network operators came to understand that it was external third parties, rather, which had the initiative, time and resources to develop new service concepts. In addition, they appeared as being better equipped to know which services would be accepted by the market; how to market and price them "correctly"; in addition to being able to associate their brand with a wider variety of services than the network operators. Actors such as, for example, media windows, including newspapers, magazines and TV-broadcasters also demonstrated their ability to provide relatively inexpensive marketing space for their own SMS services. At the same time, these external actors were urging for market wide access to subscribers.

To meet this situation, the mobile phone network operators launched the public Content Provider Access (CPA) platform in 1999. While internal initiatives were taken by the network operators, proactive external actors played an important role in pushing the operators to introduce the platform. Their role in propelling the development of the platform has continued through for example application houses bringing together the network operators to develop service concepts such as interactive TV shows. The CPA platform enables external content providers to provide SMS services in a transparent manner, and charge subscribers for those services through the basic SMS structure (currently 0,15€−8€). Thus, the operators did not choose to compete on *differentiation* of services exclusively provided in one of the networks (as they previously had), but on the contrary pursued an "open garden" approach to increase the size of the total market. The typical content provided over the CPA platform comprises yellow pages, ring tones and logos, TV-interactivity (voting and chat), games, news, stock quotes, weather information, traffic information, horoscopes, jokes etc. This is today the basis for an economically sustainable business with a total annual turnover of approx 1 billion NOK (125 million €) in 2004, a substantial growth from 600 million in 2003.

Content acquisition is initiated by subscribers requesting content by sending an SMS (Short Message Service) to certain short numbers (e.g. 1999). The SMS is processed by the message center (SMSC) of the network operator and forwarded to the respective content provider by the CPA platform. Content providers have agreements (with similar request numbers and rating classes) with both network operators, making the platforms and the network operators transparent for the subscribers. The content provider returns the content to the subscriber via the CPA platform, and the cost which the subscriber is to be charged (on the regular phone bill) is specified with a rating class. Based on this, a billing request is sent by the CPA

platform to the billing system of the respective operator. The revenue generated is basically shared between the network operator and the content provider as per an agreed (and standardized) revenue-sharing model (respectively 30/70).

The technical implementations of the CPA platforms by the network operators have been simple (both implementations were originally based on the previous platforms, only with additional open interfaces), at least partly as a result of these services still being considered as "value adding". At the same time, because of the network operators' legacies of message centers and billing systems in addition to the competition among them, close co-ordination such as standardizing the CPA-interfaces for content providers have not been feasible. These different interfaces is at least creating a higher entry cost for new content providers, however both integrators and aggregators provide support. While the integrators provide applications which deliver one common interface for the platforms, the aggregators further provide access to a short number and handle the administrative interaction with the network operators.

In table 1, a comprehensive picture of the value chain is drawn with roles and tasks. While the different roles appear as independent, several actors may play several roles. For example, large aggregators collecting content from several content producers as well as content providers commonly also act as content providers, application houses and integrators. Some media windows, such as media houses and TV-broadcasters typically capitalize on their content as well as their media window for marketing purposes.

*Table 1.* Roles and tasks within CPA

| Roles | Tasks |
|---|---|
| Content producer | Content production |
| Content provider | Content production, service innovation |
| Aggregator | Service innovation, content aggregation |
| Application house | Service innovation |
| Integrator | Providing common interfaces to CPA platforms |
| Network operator | Transportation, billing |
| Media window | Marketing |
| Subscriber | Consume content services |

Guidelines related to which services that can be provided, how they are marketed and how the subscribers are treated, have been important to avoid behavior that may jeopardize the market the CPA platform has created. However, coordinated guidelines were not formalized and introduced until late 2004 (based on regulations and discussions with The Norwegian Competition Authority, The Consumer Ombudsman and The Data Inspectorate). Up until then the majority of the content providers were cautious as not to bring the platform into too much attention from the media

and further the authorities. Provision of content services for fixed line phones in Norway are strictly regulated when it comes to content; for pricing as well as revenue sharing models. The risk of the introduction of a similar regime for the CPA platform made content providers and network operators even more eager to avoid misuse and media attention.

The network operators' delegation of the responsibility of developing new service concepts and bringing them to the market to external actors have shown successful in the sense of increased traffic and a much broader service offering. The CPA platform is not a detached platform provided by a network operator, but appears more like an assemblage of a range of different actors with their respective initiatives, investments and their technical components. On the one hand, the network operators have arranged for them selves a highly favorable revenue share model while still being in control of the value chain. At the same time, farming out the responsibility for further technical development to actors such as application houses, they are left with marginal expenses. On the other hand, the other actors are rather small, having the responsibility for developing new services and service concepts, and receiving limited revenues as they in the 'worst case' must share with several other actors (content producers, content providers, aggregators, application houses, integrators and media windows). Primarily being based on only a handful of employees, they are also usually opportunity based in the sense that they are narrowly focused on developing services which are 'trendy' and selling for the moment. They are thus neither very well equipped and thus not primarily focused on introducing new service concepts. As long as CPA is the only alternative for providing this type of content services, the services will at the same time have to conform to its business model and the kind of services it supports.

## 3.2      Mobile Content Distribution

Multimedia.com is an independent provider of mobile games and marketing applications. They started out in 1993 as a small start-up with grand ambitions and only two owners, both of which were employees. Today the company has around 120 shareholders. Early in the nineties the focus was on Internet-technology, games and direct (demographically-based) marketing and animation. Eventually Multimedia.com turned towards the mobile market during 1998-1999 and started working on algorithms that made 3D-animation on mobile phones possible via very limited bandwidth. This culminated in several successful demonstrations in collaboration with Ericsson (at e.g., Telecom 1999, CeBit 2000, GSM 2000, etc.)

Unfortunately, the market for such applications never really came about, and the company has been struggling since 2000 with finding a value

proposition that customers (mainly operators) would find attractive. They have ended up producing and deploying consumer oriented content to mobile phones: Logos, ring tones and games. This activity mainly takes place in the subsidiary MultimediaContent.com Ltd, which has distribution agreements with several operators and "storefronts" on the web worldwide (Norway, China, Italy, Hungary, etc.). Over 100 content providers have entered into signed agreements with MultimediaContent.com Ltd, and they have also signed an exclusive five year commercial agreement with one of the larger divisions of a Chinese operator to provide premium SMS and data services. MultimediaContent.com has developed a technology-independent platform for mobile content management, provisioning and distribution, based on experiences from another subsidiary of Multimedia.com, DigitalMobility.com Ltd.

Distributing content to mobile terminals is based on SMS and WAP. SMS is the carrier for requests. WAP is the 'application protocol'. The application server (which is, for all practical purposes, a virtual machine that makes its "applications" available on the internet via an interface that wraps simple data types in XML) creates on request (received via a SMS gateway, for instance) a Push Access Protocol (PAP) message which is then sent to the WAP push-enabled mobile telephone across SMS. The technical co-ordination, thus, is quite simple: The users send an SMS to the operator, with the name of the item that they want. The operators CPA-platform (or equivalent) recognizes the number, associates that with a content provider and queries their "MultimediaContent.com-platform" (or equivalent) for the URL of that item for that particular item. The application server gets the URL and produces a PAP which it sends to the Push Proxy/Mobile gateway. From there it goes to the user's phone, which fetches the content suing WAP with SMS or GPRS as a bearer.

The technology involved is really simple, but the business is risky. No-one knows in advance exactly which "applications" (ring tones, games, logos, etc.) will bring in enough money to defend development costs (and recover sunk costs for failed attempts). When the first-movers successfully established themselves in this business, the costs of development were lower; there was less competition and the consumers were less demanding. Now, one must look at the co-ordination between actors in this setting from different angles, e.g., as parts of a political and tactical positioning towards a more mature market. The parties need to do practical knowledge management since they are not at all "self-contained" with regards to the competencies that are required to implement an "end-to-end" service. They need to implement risk management (and risk sharing) strategies, since succeeding with a "end-to-end" service requires a much greater investment than what each party can afford individually (given that they do not know in

advance what exactly will become a "hit" in the market), etc. Therefore, co-ordination in the commercial aspects of this case is a lot more involved. *It does the work of orchestrating many small contributions into a larger offering that the market, in sum, just might end up paying enough for.* The various involved actors' roles and their tasks are summarized in Table 2.

The roles presented in table 2 overlap nicely with the requirements of consumer content for the impulsive, highly mobile customer: The storefronts market content by building a strong brand name; they subscribe to content from aggregators who take the responsibility of testing the content for all the handsets supported by an operator in an area. Developers need aggregators in order to handle internationalization and testing for them. Operators are "bit-pipe-carriers", plus they can do the billing effectively. Web hotels have an established role. It is probably not critical, but since most of these actors are small (typically 2-20 employees, which is already more than they can defend in terms of cash-flow), they would probably not be willing to try to handle hosting themselves for such small volumes of traffic.

*Table 2.* Roles and tasks in mobile content provisioning

| Roles | Tasks |
|---|---|
| Game developer | Conceptualizing, implementing and carrying out programming projects which produce games, typically for the J2ME platform. |
| Content provider | Managing rights and technical adaptation of content for various platforms, such as ring tones, logos, etc. |
| Aggregator | MultimediaContent.com's role. The most important task is to compile a set of appealing services and introduce them to "storefronts", i.e., web-portals. They also test content for the relevant mobile phones in the market. The aggregator pays the developers. |
| Storefront | This is the media window that the consumer sees, e.g., on the web, which "brand" and present a collection of content (from various or only one aggregator) in their market. |
| Network Operator | The owner of the technical infrastructure makes sure that there is capacity and capabilities in the network to deal with the requests and the traffic. Moreover, in the mobile telecommunications industry, this is the "owner" of the customer and, thus, the role that can cost-effectively perform billing. |
| Web hotel | Stores the data. Any data. The telephone will fetch content here given the URL that it received. |

To summarize, Multimedia.com started out trying to invent and introduce revolutionary and "disruptive technologies". However, they seem to have ended up in a more modest "Kirznerian" role of an entrepreneur that "promote equilibrium" within the existing system as they "discover gaps, increase the knowledge about the situation and reduce the general level of uncertainty[9]." Multimedia.com's subsidiary MultimediaContent.com makes

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[9] Staffan Hultén, Stockholm School of Economics and Ecole Centrale Paris, and Bengt

it possible for 'small developers to take great risks', by introducing their content together with a critical mass of others into a market that has a limited albeit smoothly coordinated business model.

## 3.3      mPay

mPay is a mobile payment solution developed in 2001, owned by Scangit AS in Norway. Currently this organization offers primarily a parking payment service, and has service agreements with private and public parking organizations in Norway such as EuroPark, P-Compagniet, the city of Oslo and other municipalities around the capital. The concept for this service is that customers are able to use their mobile phone in order to pay for or extend parking rather than using coins in the parking meter. The motivation for people to use the service is the convenience of not having to find coins and the ability to pay for the exact amount of parking used (no overpaying and no forgetting about the parking meter). While the mobile payment service is today offered only for parking, mPay hopes to expand their payment solution to other products and to other content providers in the future. Thus, mPay can be considered both a payment solution service and a content provider.

In order to use the mPay service, customers need to register via the Internet, entering their personal data including their credit card information for payment. This information is all stored by mPay. Once the customer is registered, they are able to use the service by sending an SMS message through their mobile phone. Payment for the services initiated by the customer is managed by mPay and performed in cooperation with major credit card banking institutions including Teller (formerly Visa Norway), Euroconex and Nordea. Once customers send an SMS message to pay for the product (parking), the message is transferred through to mPay, who matches the message with the registered customer information. This customer information including the billing information is then transferred to the banking institution on a regular basis for payment for the service. Thus, mPay is essentially a payment solution service that acts as an intermediary between the customers, potentially other content providers and the banking institutions, carrying none of the risk associated with the transaction.

mPay originated through cooperation with EMT, Estonia and, as a content provider for parking services, currently has only one main competitor in Norway – EasyPark. EasyPark was established in 1998 and is

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Mölleryd, Stockholm School of Economics and Stelaco: *Entrepreneurs, Innovations and Market Processes in the Evolution of the Swedish Mobile Telecommunications Industry*, Paper presented at the Eighth International Joseph A. Schumpeter, Society Conference, 28 June – 1 July 2000 in Manchester

the current leader for mobile parking payment in Norway with approximately 12,500 customers.    Both mPay and EasyPark afford customers the ability to pay for parking services through various means, including via major credit cards, such as Visa or Mastercard. While mobile payment for content via credit cards is not a unique situation in Norway and other services exist which also provide such capabilities, the mPay model is of interest as it offers the ability to establish payment for content via a channel not necessarily under the control of the network operators, as is the case for most services and models currently available in Norway.  One of the few exceptions being 'electronic wallet' type services such as Payex, which resembles the mPay model as it provides customers a payment option other than one closely associated with the mobile network operators. The main differences being that Payex primarily requires consumers to 'fill up' their account prior to being able to purchase content whereas mPay debits or charges purchases directly to the credit or debit card as 'content' is purchased.

As a payment solution service, mPay has become another actor in the overall m-services value chain and hopes to offer a new alternative to content providers often frustrated with the CPA model described above. However, as a new actor, the roles and responsibilities of the various players in the value chain have shifted slightly where some tasks previously managed by the mobile operators, such as managing customer information or billing, are now managed by mPay (see Table 3).  Just as in the CPA case, several actors in this value chain may play several roles, for example with mPay providing payment for parking services it is playing the role of a content provider as well as payment intermediary.

*Table 3.* Roles and tasks in mPay

| Roles | Tasks |
| --- | --- |
| Network operator | Provide infrastructure and network |
| Content owner | Own content, agree content availability to market |
| Content provider | Provide content services to market, manage agreements with content owners |
| mPay | Manage billing for content consumed; manage agreements with content providers and banking institutions. Manage all customer information |
| Banking institutions | Provide billing for content consumed, manage payments |
| Consumer | Consume content services, register as mPay customer |

Once the consumer is registered for the mPay service, mPay manages this customer information and the billing for content consumed. Actual billing for this content is handled through regular visa, MasterCard, etc. bills by the respective banking institutions as described above. Thus, one of the major changes in the mPay model versus the CPA model is the control of

customer information and billing. In addition, because mPay essentially manages contact between customers, parking institutions (content owners) and banking institutions, the key to the mPay service model rests primarily on coordination and agreements, many of which were established and are managed through informal networks by the founder of the service. These informal channels have thus been a key to the initiation of the mPay service and its beginning successes in the market

## 4.       DISCUSSION

We can now explore the activities and the interdependencies between the cases while also investigating possible simultaneity constraints and eventual outsourcing of responsibilities and work. This will of course be quite a simplification, but still, it can perhaps point either in the direction of general trends in this market, or towards areas in which a future theoretical framework could be used.

In each of the cases, the activities and goals of the actors converge at a general level and can be discussed in relation to the coordination of processes surrounding content acquisition and distribution. For example, in establishing the CPA model, the primary goal for the network operators seems to have been to provide a channel for content owners to sell and distribute content (and thus generate network traffic) without giving up control of the physical infrastructure or the customer relationships that they currently have. Thus, the CPA model is a win-win for the network operators as it requires little effort on their part while they gain revenue in the form of revenue sharing from content sold, increased network traffic and increased potential customer support. The mPay model, on the other hand, can be viewed as one competing solution to this CPA model as mPay hopes to establish a relationship with customers themselves and manage billing information, etc. such that they can offer content providers another option for the billing of content. Finally, MultimediaContent.com is essentially a content aggregator with the objective to compile a sufficiently interesting set of services into one "packaged" offering, and then make a profit from "brokering" these services.

Coordination of these activities seems to takes place through standardized agreements and interfaces: The CPA is a "one-size-fits-all" contract with entrance costs that also serve as a threshold for small, independent content providers. Instead, operators want aggregators to deal with the content providers. The operators channel traffic through to the storefronts, which return input and the price to be charged, and accordingly initialize billing. Apart from that, operators (automatically) generate SMS

and WAP push-messages through their infrastructure and all they see are SMS messages and URLs. Aggregators make sure that the content is tested and they take money from the storefronts, which they split between themselves and the content providers. Again, this is regulated by standardized contract (in the MultimediaContent.com case). Similarly, mPay mediates a standard contract between the customer and the banking institution. Basically, they are virtual "machines" that imprint the voucher and send an electronic copy to the credit card company.

Looking at these three cases together, it becomes clear that a lot of the coordination work that is carried out aims at reducing risk and minimizing variable expenses for each of the actors. For example, mPay's role as an intermediary allows them to offer content without carrying any risk associated with the transaction, leaving this to the responsibility of the banking institutions. Similarly, the CPA model essentially alleviates the operators from any risk associated with unfavorable or illegal content by positioning this task with the content aggregators. At a general level, this all is a strategy of optimizing locally, and it is not really representative of tremendously innovative or "disruptive" technologies. This is perhaps the single most interesting point that can be identified from our fieldwork: There are no 'disruptive' technologies at play, and this is certainly something worth looking more keenly at in future research. For instance, Multimedia.com, as a typical 'dot.com' company with highly 'disruptive' ambition ended up (finally) being successful at making a modest profit from locally optimizing one existing step of the value network in telecom, rather than revolutionizing it.

What then is the effect of this local optimization? We think that the question should be turned around: *What is the reason that we see such local (rather than systemic) optimization*? Given that most of the current services offered today (all except the yellow pages) are rather lightweight and carefree entertainment services, which are bought by the customer in a spur-of-the-moment impulsive transaction, the cost of building, marketing and billing is rather out of proportions with the actual price that one can expect the user to be willing to pay. Building an 'innovation infrastructure' on top of which new businesses and truly innovative application ideas can be deployed is a tremendous challenge, which we will continue to address in our research. And while the network operators have created new business for content providers by implementing CPA platforms according to a "open garden" philosophy, the platforms implemented are only minor extensions of their existing infrastructure and the network operators' control over the value chain is far from being challenged and deconstructed into a value network.

Within these case, the interdependencies are evident, much of which is related to the 'outsourcing' of various tasks and processes. For example,

MultimediaContent.com outsources the hosting of content, either 'back' to the storefront or to a web hotel. This is not an ideological choice, instead it is rather pragmatic. The mother company has a lot of competencies in this area but they are all located abroad, a country from which the Internet capacity is limited and unreliable. Perhaps the most important resource in the emerging market of mobile services is the presentation of services in the context of marketing. In order for customers to impulsively buy indifferent content, such as ring tones, logos and games, the marketing has to be 'pushy' and strong. Therefore, such a simple resource as the common short number (e.g., 1999) for services across operators is a valuable resource. For the content providers, access to the validated customer database and the factoring services of the operators or credit card companies is a valuable resource. The CPA provides the necessary mechanism for preparing and pushing the WAP messages with content or URLs to the handsets.

Coordination in this emerging industry seems to be mainly about managing loose interdependencies in a non-linear value chain of actors. They are not concerned with traditional manufacturing challenges of optimizing their production lines, or even working together towards a common goal. Nor are they (as in the alternative 'dot.com'-conception of the telecommunication industry) concerned with crafting an entirely 'new economy,' which will revolutionize large parts of the society. The reality seems to be rather in the middle. Actors coordinate their efforts so that they can 'hedge' their value propositions through creating critical mass and sharing risk related to development and marketing. Thus, they can secure a minimal cash-flow and, simply, keep going.

## 5. CONCLUSION

Over the past decade, we have seen tremendous growth in the telecommunications sector. On the other hand, growth has not been uniform. Vendors still see increasing sales of new devices. A lot of it is marketed by promises made about appealing new services that will be made possible by the "next generation" technology. These promises, however, remain mainly unfulfilled. Starting to uncover why this is the case and putting ourselves in a position from which remedies may be proposed, we have analyzed one excerpt from the value chain of this industry. Although, at this stage, chiefly descriptive in nature, our research aims to create a constructive intellectual platform.

Our ambition is to move on with more in-depth studies of this field. It should be guided by a clearly defined knowledge interest, which partly has been inspired by the findings of this paper: Why do actors only *successfully*

engage in *limited* exploitation of the 'next generation nomadic computing'? Why are there such a limited number of new applications being developed and, to the extent that they are, why is the end-user adoption so modest? The contribution and development of theoretical frameworks play an important part in understanding this picture. Good analytical mechanisms may help us understand how the field is unfolding; they provide useful concept and predict change. However, empirical studies such as those presented in this paper are a necessary platform for such work in the next instance.

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APPENDIX V

Petter Nielsen and Margunn Aanestad

Infrastructuralisation as Design Strategy: a Case Study of a Content Service Platform for Mobile Phones in Norway.

# Infrastructuralisation as design strategy:
A case study of a content service platform for mobile phones in Norway

Petter Nielsen and Margunn Aanestad

**Abstract.** This paper presents the findings of an empirical case study on how two Norwegian telecommunication operators developed a business sector information infrastructure for mobile content services. Focusing on the context of and the strategic reflections behind its design, implementation as well as its operation, our findings are used to develop a concept of *infrastructuralisation*. In so doing, we draw on insights from Claudio Ciborra's narrative of the change from alignment to loose coupling in the Swiss multinational Hoffmann-La Roche. We show how control is played out on different levels, and how control is balanced against autonomy. The theoretical implications of this paper are related to how we conceptualise the differences and the transformations between information systems and information infrastructures. Specifically, pursuing the development of an information infrastructure should be understood in the light of a balance between control and autonomy. Consequently, this paper suggests that infrastructuralisation as a design approach should be based on a deep understanding of the existing control/autonomy balance as well as the distribution of resources, risks and abilities and willingness to innovate.

# INTRODUCTION

Claudio Ciborra saw the implementation and operation of corporate wide information infrastructures as intricate puzzles, as *collages* that emerged through improvisation that were torn by centrifugal forces (Ciborra, 2000a). In his critique of the conventional management literature, Ciborra illustrated how these collages undermine control oriented approaches to implement infrastructures and demonstrates how the conventional management literature have responded by deeming the collages as being dysfunctional. In his account entitled "From Alignment to Loose Coupling. From MedNet to www.roche.com", Ciborra describes the emergence of an infrastructure for external (Internet) and internal (intranet) communication in the Swiss multinational Hoffmann-La Roche (Ciborra, 2000b). Here he offers key insights by illustrating a different strategy than careful alignment; namely one of nurturing and cultivation to harness the power of the periphery. The Internet/Intranet approach in Roche succeeded a previous attempt to cater for its ongoing globalisation. During the 1980s and based on standardisation, the corporate network MedNet was implemented by Strategic Marketing as to support a new centralised role of marketing and to unify the Roche affiliates, but after eight years of development the uptake and use was low. Based on changes in the management strategy towards what Ciborra describes as 'loose coupling' and 'releasement', a different path was chosen. It was now the internationally dispersed Therapeutic Units that owned and developed this infrastructure. Central management did let go of centralised control, and found it more appropriate to let the web use unfold in its own direction. Without centralised coordination, and based on peripheral grass-roots developments, the Internet/Intranet approach was based on the alignment with the user needs rather than the internal strategy.

This paper examines an innovation process within mobile telecommunications. This is an area where formal standardisation processes have been in focus for the development activities. This implies less emphasis and awareness of the significance of improvisation, collage and processes out of central control. This is where this paper aims to make its contribution; to demonstrate in what ways control and development is intertwined. Previous attempts to account for the difficulty and complexity in developing platforms for mobile content services have not focused on how their process of emergence is related to control and how different control approaches may play out and which results they may generate. This paper describes how information infrastructures (II) are designed and operated to meet specific needs, which are mainly needs related to control. The notion of II will be discussed in the next section, where we will argue that II research need to discuss aspects of control more specifically. The existing literature on corporate II has primarily investigated and depicted control as something management always pursue to successfully manage their corporations, even to the extent as control becomes an aim in it self – control is management *per se*. Inspired by Claudio's critical thinking, and based on an empirical case study, we demonstrate that this is not always the case. We will show how intentionally disclaiming control can be prerequisites, rather than impediments for successful design and operation of IIs, arguing for a more appropriate and nuanced

control/autonomy balance perspective (Walsham 1993). Based on the findings from our case study we suggest the term *infrastructuralisation* to denote this strategy of disclaiming control.

We report from a case study of the design and operation of an II used to provide commercial content services for mobile phones in Norway. While generally m-commerce in Norway is still recovering in the aftermath of the "dot.com wave", the Content Provider Access (CPA) platform has created sustainable business since 2000. Briefly, CPA is implemented by the mobile telecommunication network operators and provides a set of services that give content providers access to the GSM infrastructure of the network operators as well as billing services. This enables them to provide and charge consumers for low-cost services in a cost-effective manner. While other m-commerce initiatives have had more limited success, at least in economical terms, CPA distinguishes itself by being an open and market wide platform. This has required the network operators to draw upon each others resources and coordinate among them selves, as well as with various actors in the content industry such as content aggregators, application houses etc. We argue that the successful design and operation of CPA by the network operators was founded on their ability to disclaim the control over the CPA platform and harness the power of the periphery. Factors such as their previous experiences with similar platforms under their control, the kind of services provided in this market and the existing regulations were influential on the choice of design strategy.

As we find the concept of control it self as under-researched related to II, the aim of this paper is to contribute to a deeper insight into how the control/autonomy balance relates to business sector II design in particular, but also to II in general. In particular we show how strategies of control (and lack of it) played out on various levels, and how the careful balance against autonomy was struck and how it changed over time. In doing so, we also provide novel insights into the emergence of information infrastructures. Further, we point out how infrastructuralisation may be the only way ahead while at the same time resulting in outcomes that are likely to be different from those of control oriented approaches.

In the next section, we provide a brief introduction to II as well as related conceptualisations of control. Then we discuss the need for a different conceptualisation of control related to the design of business sector II. Our case study is recounted and analysed to illustrate an alternative strategy which we term *infrastructuralisation*. Following our analysis, we discuss the relevance of the case for conceptualisations of information infrastructures and issues of control. In the final section we provide some concluding remarks.

# INFORMATION INFRASTRUCTURE CONTROL AND DESIGN

## Information infrastructures and control

We conceptualise information infrastructures as composed of interdependent and interconnected collections of socio-technical components (e.g. Hanseth 2000; Hanseth and Monteiro 1997; Hanseth et al. 1996; McGarty 1992; Star and Ruhleder 1996). Together, these components provide an underlying platform which upon other actors can provide services and applications, such as for example an intranet in a global organisation or Internet as such. IIs are thus not relatively simple, standalone and self-contained information systems, but rather represent large and open socio-technical networks of heterogeneous actors. The various actors have different perspectives on and only partially control over the II (Neumann and Star 1996; Star and Ruhleder 1996). Moreover, an II develops over time, through gradual expansion, improvement and replacement of its parts. Controlling an II is thus not clearly delineated neither in scope (range and users) nor time (see for example Ciborra et al. 2000; Lyytinen and Yoo 2002).

As a consequence, conventional approaches to design of information systems may not necessarily apply for II as no single actor is in control and since the infrastructure is not built from scratch within one project. New design challenges become prominent, such as for example those related to overcome start-up problems (Hanseth and Aanestad 2003) and avoid lock-ins (Hanseth and Lyytinen 2004).

While IIs are large, heterogeneous networks of components, they are never the less a result of design activities and choices. Growing out from existing installed bases of technologies, design practices and usages, the nature of IIs does at the same time make the design process a distributed activity. Even if distribution implies that II design is not one, centralised activity (in time and space), certain actors will be in a better position to shape its trajectory (Strauss 1993) of evolution. While total control over the II is unattainable (or: if someone has total control, it is indicating that the technology is rather an information system) certain parts or components are under the control of certain actors. This control challenge for II design is reflected in the literature (for example Ciborra et al. 2000; Lyytinen and Yoo 2002) and different aspects of control have been studied, such as for example how to get users to use a new II through cultivation and bootstrapping (Hanseth and Aanestad 2003; Rolland and Monteiro 2002) and how to avoid lock-ins through flexible standards (Hanseth et al. 1996).

Hanseth and Lyytinen (2004) suggest an analytical distinction between different types of information infrastructures since they vary enormously in scale and functionality. They suggest delineating between three different types of vertical information infrastructures: universal, business sector and corporate II. While universal II have a global scope and corporate II is used primarily within one corporation, business sector II involves several different (and heterogeneous) companies within a business sector. While the early II literature discussed universal II, in particular the Internet (Monteiro 1998), much of the current II literature concerns corporate II. Here the theme of control is often discussed, and these studies have emphasised the complexity of controlling II and control-through-II

(see e.g. Ciborra et al. 2000 for a collection of studies). These studies demonstrate the distributed nature of technology in dispersed organisations, and in particular how it generates tensions between the global (or central) and the local (for example Ciborra et al. 2000; Rolland and Monteiro 2002). A finding from these studies is that since technology itself is difficult to control, it may curb cooperate control as much as it enhance it:

> "Making larger infrastructures – to obtain enhanced control – means making larger and more interconnected network. Larger networks are harder to change and the role of side effects increases – which leads, paradoxically, to less control." (Ciborra et al. 2000, p. 126).

Implementing II can thus appear as striking back on management in the sense that "side-effects" become more prominent than "intended" effects.

The perspective on control in these studies is at the same time quite restricted as control is seen as something management always pursue to successfully manage their corporations, even to the extent as control becomes an aim in it self – control is management *per se*. Control or rather *lack-of-control* is seen as a crucial challenge related to II. The aims and duties of managers as much as designers are to cope with the uncontrollable nature of II, providing the required corporate glue or breaking lock-ins to suboptimal practices. What we find taken for granted throughout this literature, however, is that control over II in design and operation *always* will be pursued. We argue that such a perspective fails to see important aspects of the very nature of II and control as the need for control over technology is neither necessarily absolute, always pursued nor an all-or-nothing proposal.

Business sector information infrastructures

In this paper we primarily discuss business sector II involving complementary as well as competing actors, standards, services and technology providers within a business sector. There has to some degree been an interest in this kind of II, as evident from the studies of exchange of structured information within a business sector, such as electronic data interchange (EDI) in different sectors and industries (for example Damsgaard and Lyytinen 2001; Forster and King 1995; Nikas 2003), telemedicine (Aanestad and Hanseth 2000) and geographical information systems (Georgiadou et al. 2005). This literature is, however, not primarily focused on managerial control through II, but rather the design challenges II poses, and further how to handle these complexities (for example related to the mechanisms of network economics).

Infrastructure is commonly understood as something underlying, beneath and below. Being underlying, infrastructures can also be understood as being below a certain surface in the sense that it is transparent and invisible to its users. Only upon breakdowns, what is underlying becomes visible, such as when a water pipe splinters or a mobile telephone network fails. The current literature on II lends itself to this metaphor of infrastructures in particular when we consider the strength of their installed base and the mechanisms by which they evolve. But as with all metaphors, this analogy also has its limitations. In

particular, when discussing business sector II design, two such issues emerges. Firstly, Business sector II can be flexible in design. In design, certain actors can have strong influence on the installed base and change it abruptly, in particular changing it from a limited information system or platform into a business sector II (and vice versa). Secondly, the sunk nature of business sector II is not necessarily literal. Being sunk is primarily related to how the business sector II is recognised by other actors.

One approach to design and implement business sector II is to link together components which used to be standalone information systems into one II. Central actors must take the decision not to go for an individual, closed and controlled solution, but rather to connect to and become a part of an underlying infrastructure providing support for a range of different activities. The design choice in such settings are not just related to start-up or lock-in challenges, as has been described for networked technologies previously. The difficult decisions here are also about distribution and allocation of control, autonomy and responsibilities.


## RESEARCH METHODOLOGY AND APPROACH

Actor-Network Theory (ANT) as a vocabulary making us sensitive in spelling out the underlying aspects of II has been argued (Monteiro 2000) and shown in multiple case studies (e.g. Ciborra et al. 2000). Our research has been inspired by ANT in seeing technology and design as based on heterogeneous and socio-technical networks. By downplaying the difference between human and non-human actors' role in the design process, we have been able to focus on how the interests and intensions of designers is reflected in technology and how this is reflected in its use (for example Faraj et al. 2004). Change, or design, is thus not alone dictated by technical artefacts and their trajectories, but through a negotiation process, or enrolment (Allen 2004), involving a heterogeneous network of human and technological actors (Law 1999). Focusing on "… recognizing the depths of interdependence of technical networks and standards, on the one hand, and the real work of politics and knowledge production on the other." (Bowker and Star 1999, p. 34), the research design is centred on tracing the involved technical components, actors and their interests in the design and operation of the CPA platform.

The case study reported from here is based on 39 informal and in-depth interviews with managers and system developers in 23 different organisations related to the development and operation of the CPA platform. The interviews were focused on how the different actors value the CPA platform and how they had contributed to its design as well as operation. While being inspired by the whole set of interviews, this paper does in particular draw upon nine interviews with employees within the network operators designing and operating the CPA platform and its predecessors as well as four interviews with the content providers directly influencing these developments.
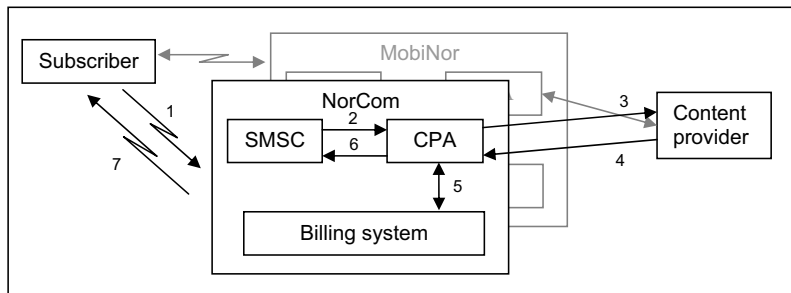
A CASE STUDY OF THE CPA PLATFORM

This section introduces the architecture of the CPA platform and how it is used, followed by a more detailed description of the process of its origins, design and development.

The CPA platform

The CPA platform is implemented by the two Norwegian mobile telephone network operators (NorCom and MobiNor) as two technically independent software platforms. Together, these platforms provide an open and public infrastructure for provisioning of content services, such as yellow pages, ringtones, TV-interactivity, news, weather information, jokes etc., for mobile phones.

   The architecture of the platform enables mobile phone subscriber to acquire services through some simple steps. For example, if a subscriber would like to know the phone number of a person X, she first locate the required information for ordering the service (for example on the web, in a magazine or on a banner), which is a short-code (a phone number with only four digits) identifying the content provider and the name or code of the content item. As a request for the content, the subscriber sends a simple SMS from her mobile phone, in our example simply containing "phone X" to for example the number 1905 (step 1 in Figure I).



**Figure I. Content service request on the CPA platform**

As a normal message, the SMS is handled by the SMSC (message centre) in the respective mobile phone network of the subscriber, which recognises the number 1905 (as a short-code) and forwards the request as well as the subscriber' phone number to the CPA platform implemented by the network operator (step 2). The CPA platform further forwards the content of the SMS to the content provider associated with the number 1905 without any processing and over a TCP/IP connection (step 3). When the content provider receives the request, "phone" and "X" are recognised as the service requested and its' input respectively. The content provider then produces and returns the proper content back to the network operator by the TCP/IP connection (step 4). Returning the content, the content provider also has the responsibility to rate the services according to predefined rating classes ranging from NOK 1 to NOK 60. Upon receipt, the network

operator requests their billing system with a CDR (Call Data Record) to handle the request according to the rating class (step 5), and if successful, the content is delivered to the customer by the SMSC (step 6 and 7). Since the subscriber is already registered with the network operator, there is no need for registration and confirmation of personal data, credit card numbers etc. and the payment of the service will simply be handled over the regular phone bill. Finally, when the subscriber pays his mobile phone bill, the revenue is split between the network operator and the content provider.

## Early content services for fixed line phones in Norway

Content services have been available in the Norwegian telecommunication networks since the introduction of Teletorg. In 1991, external content providers were granted the access to provide information services (voice based) to fixed line phones. This model was based on the current monopoly PTT network operator offering the possibility to premium rate the use of certain number series (820 and 829) and handling the billing of usage over the regular phone bill. The network operator was, however, only to take a production cost charge for handling the billing according to specific regulations due to its monopolistic (and thus strong) market position. While a range of services were non-utility based, such as chat, horoscopes and jokes, other also contained explicit content. Based on an initiative from the network operator and "IL-forum" (representing the content providers), Norwegian authorities established "Teletorgrådet" in 1991 to monitor the services provided as well as later enforce regulations and laws particularly developed for Teletorg services. The brand of MobiNor, at that time the only telecommunication operator in Norway, could at the same time not be related to this kind of services. Teletorg was thus not presented and marketed as a single initiative made according to the profile of MobiNor, but as a commercial interface for third parties where they were free to provide commercial services in the network.

## Proprietary mobile phone platforms as an interlude

In 1993, MobiNor was for the first time experiencing competition on their mobile phone network by the insurgent NorCom which over time have managed to capture approx 30 percent of the market. In 1996, both operators started to implement platforms for exclusive content and utility-based SMS services for their respective mobile subscribers for differentiation purposes, both launched in 1997. Besides this closed and non-public approach, service acquisition was almost following its successor; the CPA platform. One important difference was that the content services were charged for regardless of content and simply per transaction as regular SMS (NOK 3). This was felt as a "tragedy" by the content providers, in particular those with previous experiences with premium rating from Teletorg. This also made service offering limited since it required small production costs (or high volumes, which was not the case).

Both of these initiatives developed ad-hoc and were based on the initiatives by a small number of enthusiastic employees. These unstructured approaches did not require a good

business case, but as a consequence they also suffered from lack of funding. This situation was at least partially relieved by joint activities with content providers. As another important difference compared with the CPA platform, the different initiatives provided exclusive services and were at the same time controlled by the network operators, as noted by the founder of the platform implemented by MobiNor:

> "… We were talking directly with the content providers, it was us that fixed the codes, so, the point was that the content providers had a relationship with us, and we fixed the rest. We were, so to say, an editor which defined which services to provide"

Being focused on services being reasonable in building their brand and according to their profile, the content services sold by the network operators on the platforms were thus primarily utility-based, such as national news, stock quotes, weather forecasts and phone directories.

The primary challenge implementing the platforms for the network operators was to make required changes in the billing systems. The billing system was at this time rather immature since mobile telephony was in its infancy, implying that running the billing of voice on a day-to-day basis was the single most important priority. Getting priority to get changes implemented within this context, even if only requiring minor technical efforts was complicated. The unstructured approach in developing the platforms and the lack of managerial support did not make this situation easier. What turned out to be the most sensible approach was to develop platforms operating, at least temporarily, outside the billing system, as commented by the founders of the platforms implemented by MobiNor and NorCom respectively:

> "When we made a new product with a new price in minutes, they used months to do the same in the old billing system … So it was just not possible to be dependent on the billing system to have the flexibility we needed. So we managed to do that by defining us out on the outside. And you can say that at that time the most flexible billing system was running on a PC in the corner of one of the developers' office."

> "It was not very easy to change things. We had our first version of our billing system … with flat files and everything, it was a real threshing machine … and when the new billing system came, we were tied on hands and feet's both by technology and possibilities. So, everything was premature deluxe … I remember we hacked everything, because we had no resources for developing …"

While these "ad-hoc" efforts made the platforms operational on the technical level, they did not create a very successful content service market. On the one hand, the network operators did not experience an economic success with their exclusive service offerings. This was at least partially because of the cost of marketing services for only a fraction of a rather small market, and partly because the services were primarily utility-based. On the other hand, the few content providers involved expressed their frustration over what they saw as the potential in a different and sounder service portfolio and pricing policy.

During fall 1999, an employee of MobiNor who had previously been working with one of the most central content provider and TV-broadcaster NTV for a while, returns to MobiNor. Being well aware of the problems with the platforms, he immediately engages in changing the current approaches. At this point in time, another employee in NTV working with the previous platforms was also engaging in several discussions with both the network operators. These discussions were for example related to the possibility to

charge the services for more than the basic SMS price (premium rating). However, the network operators were not taking the suggestion to charge 5 and 10 NOK for content services seriously, but were rather felt to ridicule it:

> "So, we felt for a long time like banging our heads to the door there, and this was not because technical issues, because that was the next thing, then one had to build that in addition. The problem was that they simply did not believe that it was possible to create revenues of from it."

## The emergence of the CPA platform

As a result of outside pressure and internal discussion, MobiNor initiated the development of a new and different platform. A similar process was also unfolding within NorCom. These efforts were primarily based on the ideas that content providers are better equipped with market knowledge as to develop new services, market and price them "correctly"; content providers can associate their brand with a wider variety of services than network operators; and content providers must have market wide access. Based on these ideas, the decision to change approach from the previous platform was rather clear. But again, the management efforts and the investment in the further implementation of the new CPA platform were limited. As a consequence of this, the initial technical implementations of the CPA platforms by both operators were primarily based on the previous platforms, just opened up for external content providers. Because of lack of support and resources, only on a day-to-day basis a few key people from the network operators managed to develop the necessary software and relations among the network operators and with content providers, as noted by one of its founders in MobiNor:

> "… It was a bit of entrepreneurship spirited, the project, because we had no resources assigned like you are used to in a big company. So we had to make everything ourselves, and find the resources ourselves, in a form of a project. And this resulted in, that the atmosphere, both market wise and business wise and the technical development was entrepreneur directed."

The very first content providers signing a CPA agreement knew very little about mobile telephony, but had experience with providing non-utility services at the Teletorg platform. Based on rumours about a new platform, and after trying for months to get access they finally could provide services on MobiNor's platform. It was, however, clear that the platform was on an early stage and still even controversial within MobiNor:

> "And then they had something running … and suddenly I showed up, but they had not planned to launch at this early stage. And they had to sort out, what do we do now? And that is difficult in this kind of an organisation. So, finally by being persistent, I could plug into the platform, but it was made clear that the billing could fail to function at any time and without any rights for me to claim compensation."

> "[MR. X] meant a lot for this, he did a lot that he was not allowed to by his manager. He stressed this through internally in MobiNor, in a way that he possibly would not if he were a devoted and nervous guy. So he was scolded a lot in the beginning …"

The developers as well as promoters of the CPA platform were in this situation equipped with the ability to pursue what they called a "no-telecommunication" like approach. As the platform emerged, the cost of its implementation and operation turned out to be marginal for the network operators, while the traffic was increasing rapidly. This was

also at the heart of the strategy, as noted by one of the middle managers involved from MobiNor:

> "We have not used many resources on marketing the content providers' services, which was a part of our strategy, that we initiate variety and minimise risk. Because there is many that give it a try, those who succeed we make money on, those who fail is not our problem."

When launched in the spring of 2000, the CPA platform enabled content providers to deliver a wide range of content services to mobile phone subscribers and at the same time bill (premium rated) the subscribers for using the services. The responsibility to decide which services to provide, how to market as well as price them now rested with the content providers. While previous platforms were network provider specific, CPA is a public approach; building one, transparent market for the content providers and the subscribers. From providing relatively simple services as ringtones, logos and stock quote subscriptions, the CPA platform is today also providing more advanced services. In particular, CPA has become integrated as an interactive return channel for voting and discussions in TV-shows. To coordinate these events, the TV-broadcasters, content providers and network operators have a close dialog to enable and further develop concepts. The CPA platform today also provides billing support for content services delivered by MMS, WAP, Web, and positioning. In 2004, the industry in Norway had a turnover of approx 1 billion NOK, involving approx 50 different companies with 250 employees.

## ANALYSIS: DISCLAIMING CONTROL

Before users were allowed to attach own equipments to telecommunication networks, the distinction between users and vendors was clear (Branscomb and Kahin 1996) and the incentives and the responsibility for service innovation and operation were assigned to the vendors, i.e. the network operators. The responsibility and the primary control are still resting with the network operators, also in the case of CPA, even if multiple actors are plugging into the network operators' systems. In our case, this control/autonomy balance is played out on two levels. Firstly, employees within both network operators were enjoying the autonomy to pursue their personal initiatives in an entrepreneur like spirit by developing the CPA platform. This autonomy was at least partly a result of the common lack of interest from management in services which are found economically marginal and appears as odd practices and more like serendipitous applications of systems (Ciborra 1994). Secondly, those pursuing the development of the platform within the network operators realised that they were not equipped with the resources, the risk willingness, and the ability to innovate and create the range of services which the market really 'wanted'. Through the design of the CPA platform, however, the network operators offered the content provider the flexibility to autonomously innovate and exercise their risk willingness in providing services. By giving away control, the network operators did at the same time disclaim the responsibility for the services provided, which may run counter to their desired 'public image'.

CPA was designed, implemented and launched in an unstructured manner and beyond strict strategic and managerial control. At the same time, the adverse resources situation had influence on the very architecture of the platform, in particular related to the low-on-resources approach. While stronger managerial control and requirements for a sound business case would not necessarily have led to a rejection of the platform itself, it would definitely have impeded the process and most likely resulted in a different, and most likely a more proprietary architecture. Thus, in this case, lack of managerial control was not a challenge, but rather a prerequisite for shaping the control architecture of the CPA platform and allowing for and suggesting an approach of infrastructuralisation (i.e. pushing the CPA 'out' of the operators' domain).

Providing autonomy has further alleviated the network operators from the risks associated with unfavourable, explicit or directly illegal content by positioning the responsibility for the services and the service provisioning with the content providers. They have not only shown a much better understanding of the market, but are also less concerned about the nature of the content. This quickly showed as useful in spurring a range of different and rather unpredictable activities, as noted by one of the founders of CPA in MobiNor:

> "It was primarily colourful advertising, jokes and really just nonsense. But, it appeared as what the subscribers wanted … What these guys new was that the willingness to pay for services was high … so they began at an early stage to charge NOK 10 for services … So, during a very short period of time, the turnover went far beyond the previous platform, without any investments in service development or marketing *et cetera* by us."

Actors within a business sector will follow strategies as to maintain the control over their assets and their position in the value chains. With this perspective, changing approach from strictly controlled and exclusive content service offerings can be perceived as risky. In the case of CPA, the operators have managed to protect the core parts of their value chain, such as for example their relationship with, or ownership of their subscribers. Recently rejecting a company which wanted to implement their own CPA platform within the network of MobiNor has reinforced the network operators' position. The rejection was interestingly supported by the Ministry of Transport and Communication partially because MobiNor have limited control over the services provided on the CPA platform. Thus, while the architecture of the CPA platform is leaving the network operators with little control related to service provisioning, it favours and reinforces their control over their technology and value chain more widely.

The architecture of the CPA platform compared to its predecessors is shaped by disclaiming control and delegation related to marketing, pricing, innovation and risk. Partially, this delegation has been in terms of investments and operational costs. At the same time, and more important, the delegations in terms of responsibilities and control makes this platform appear as a business sector II. While delegation in some instances has been imposed by the network operators, in others, the content providers have proactively pursued autonomy since they need the control to more smoothly innovate and introduce new services. This architecture and balance of control and autonomy has

developed over time, and perhaps more as a result of network operators' technical limitations and lack of interest rather than their overall strategies.

The efforts of the network operators in providing CPA as an open and public business sector II show how II can be designed and emerge with very limited efforts. It also shows how the sunken nature of the information infrastructure is not necessarily of a literal nature. By *infrastructuralisation*, the previous standalone platforms were redesigned as only one element in a shared infrastructure. This process of sinking primarily relates to how this platform now appears as only a transparent infrastructure whereas content providers can provide their services. At the same time, while network operators have withdrawn compared with their previous platforms, content providers are brought forward and into the light as those taking initiatives, innovating and being responsible for providing services and perpetually extending this collage.


## DISCUSSION: CONTROL AND INFRASTRUCTURALISATION

Control over technology can be argued to provide huge benefits by enabling certain actors to lock other actors and solutions out and create favourable revenue streams (Shapiro and Varian 1999). The concept of control should, however, be expanded along several dimensions to show its variety of facets. First, control is not necessarily determinate and can be conceptualised as on a continuum from absolute to only influential (Beniger 1986). Second, control in relation to II will also be understood different from different perspectives, as has been so clearly portrayed in the local-global discussion of corporate II (e.g. Rolland and Monteiro 2002). Third, real and perceived control may play equally significant roles. Fourth, the distinction between controlling business sector II and controlling the use of business sector II are crucial. Fifth, and not least, control and autonomy are inseparable aspects of management (Walsham 1993). Human actors are always autonomous to a certain extent, but their choices will necessarily be restricted within the political context of organisations as well as business sectors. At the same time, and equally important: "Control must be balanced in a sensible way in order to gain the benefits of the creativity and energy which raises from autonomous activity on the parts of individuals and groups" (Walsham 1993, p. 45). The approach to the control/autonomy balance can be linked to certain *responsibilities* which come with the provision of technology. When such responsibilities become too problematic to take for those in control of technology, one possible strategy may be to disclaim control over the technology, i.e. through a strategy we will describe as infrastructuralisation. Thus, the technology becomes to a certain degree "autonomous" and in the hands of other actors. In this context, II are important means by which control can be exercised and autonomy facilitated. A key challenge is thus to balance between control and autonomy in design as well as operation of II.

As our case study illustrates, providing the CPA platform publicly yielded some benefits as well as came with some responsibilities. While centralised control over a technology platform can provide the benefits of one actor, control will also be attached

with responsibilities related to the use and the consequences of the technology. How the relations between technological control and usage control are configured will be of crucial importance as to how the accruing responsibility will be distributed. If the responsibility of usage of the technology platform is given to those in control of the technology, technology providers have to deal with how the technology is used. They either have to implement mechanisms which strictly hinder unacceptable use, or they can alternatively withdraw or disclaim their control over certain parts of the technology. The former approach will necessarily be costly as well as act in a limiting manner for the users, but also in accordance with the common control perspective and approaches in the II literature. The latter, however, will rather limit the expenses of introducing and operating control mechanisms for the technology providers as well as it will open for free and open usages.

Even if promoters of "open" technology inevitably sacrifices some control over the future evolution of the technology (Tassey 1995), giving away the full control over technology is a radical approach. A more refined and likely strategy is rather to make the technology appear, and thus being externally perceived as out of central control. This implies to retain control over certain parts of the infrastructure while at the same time providing technology for open use – an appropriate control/autonomy balance.

Our case study shows how two companies by engaging in the provision of a business sector II disclaimed the control over a technology platform. This they did on order to spur innovation and to fit their relation to the regulatory regime as well as avoided risking their corporate profiles and reputation. Providing the core components of the business sector II, these companies one the one hand controlled the architecture of the business sector II, while on the other hand, it was the users of the II which had the control over and the responsibility for its usage. The actual way in which disclaiming control was operationalised in our case was to slightly adjust the technical platform for service provisioning. Rather than continuing to be independent and self-contained information system under the respective control of the two actors, it was redefined to be only a part of an II.


CONCLUDING REMARKS

In Claudio Ciborra's work, infrastructures are tools which are used to interconnect, structure and control organisations. At the same time, both infrastructures and organisations are permeated with surprises, blockages, diversions and side-effects. Claims about how to develop information infrastructures are inevitably claims about how to control organisations and human beings as well as the infrastructure itself.

Control related to technology is a complex matter and it is not an all-or-nothing proposal. The control/autonomy balance is played out on various levels related to the design, implementation as well as the operation of IIs. And this is not only between management and the periphery of corporations, but also expands beyond and out in the

business sector. While control over technology is crucial in some circumstances, avoiding the repression of attempts to unlearn old ways of thinking and doing (Ciborra 1994) and disclaiming control over at parts of the technology such as its usage can be equally essential in others. Control is thus not necessarily always pursued. Strategically, developing business sector II can be one approach to pursue rather the opposite; by disclaiming control and allowing for autonomy. The risks related to being in control over the CPA platform were early understood by the network operators as potentially hampering the possibility of implementing and operating such a platform. Thus, through an infrastructuralisation strategy, control and responsibilities was disclaimed by the network operators in favour of the content providers. While real control over the technology still primarily rest with the network operators, its infrastructure nature have enable them to withdraw from responsibilities in the sense that it is externally recognised as out of their control. The technology is not itself autonomous, but the content providers as users of the II are controlling the usage.

While infrastructuralisation provides the opportunity for the network operators to engage with technological architectures which would not have been possible if they rested with the responsibility of its usage, infrastructuralisation also has important implications for the autonomy, openness and possibilities for technology usages. Borrowing from Claudio's and others language of IIs, while certain *side-effects* no longer have repercussions on the infrastructure providers, the infrastructure at the same time allows for creativity as well as eccentric usages and innovations. In these circumstances, the control/autonomy balance appears as being favourable both for network operators, content providers and innovation in general. Practically, then, this paper suggests that this transition should be based on a deep understanding of the existing control/autonomy balance as well as the distribution of resources, risks and abilities and willingness to innovate.

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APPENDIX VI


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Open Standards for Mobile Content Services: a Case Study of the Norwegian CPA Standard.

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# Open Standards for Mobile Content Services
## A case study of the Norwegian CPA standard

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**Abstract**

This paper theoretically and empirically discloses transformations in the 'world of standards' and the challenges it creates for current and future standardisation in the turbulent and complex environment of m-commerce. This paper discusses the increasing complexity and pervasiveness of standards and standardisation processes as the result of an increasing number of standards, links between them and actors involved in their development. While these processes create demand for additional standards, we point out how different kinds of standards and standardisation approaches are required – not just more of the same. Developing a case study of a Norwegian standard for m-commerce and comparing it with the Japanese i-mode standard, we illustrate a range of important qualities and characteristics of standards in a field that reflects these transitions. While there are various meanings attached to and definition of open standards and standardisation processes, openness is intrinsically related to flexibility and innovation. We show that these relationships will be influenced by the characteristics of standards and standardisation processes as being open, complete, simple, informal, flexible, robust, as well as building on the installed base. The study finds that open standards are important for m-commerce, but more important that these standards must contain more than specifications of technical interfaces, and include the 'package' of other things to be agreed upon to coordinate and make things work.

# Open Standards for Mobile Content Services
## A case study of the Norwegian CPA standard

## 1. Introduction

It has been predicated that the future will be filled with a variety of mobile devices, services and business opportunities. As part of the 'dot.com' era, one promise to take us in this direction was electronic commerce carried out via mobile phones (m-commerce). In the aftermath of 'dot.com', however, it is clear that by in large, these promises and the more general predictions have not been met. At the same time, the current picture of m-commerce is not all negative. Certain attempts have indeed been successful, as for example the much cited Japanese i-mode standard for mobile content services (e.g. Funk 2001). Another less well known case, which we discuss here, is the public Content Provider Access (CPA) standard in Norway. While i-mode is proprietary and fully controlled by the mobile operator (NTT DoCoMo), as is the case for most of the standards and infrastructures for mobile content services, the Content Provider Access platform is an exception. The aim of the research reported here is to inquire into these standards and their openness. More specifically our aim is to answer the following research questions:

- What kind of standards do we need (or what needs to be standardised) for the development of mobile content services and their infrastructures?

- Which features (beyond functionality) should the standards have?

- What kind of standardisation approach is appropriate in this area and how should the standardisation activities be organised?

- Why did an open standard and platform emerge in Norway – or more generally: what are open standards, under what conditions will open standard for mobile content services emerge?

Our concluding answer to these questions is that there is a substantial need for open standards in this area, just as in other areas within telecommunications. But the complexity in terms of the number and

diversity of actors involved and the unpredictability of user needs and future markets for these kinds of services, demands different kinds of standards and standardisation approaches. The CPA case demonstrates both the important role of open standards in this area as well as what such standards may look like and how they may be developed.

The paper is organised as follows. Section 2 presents related research on standards concerning innovation, flexibility and openness. In section 3 our research approach and methodology is outlined. In section 4, our case study is presented, followed by an in-depth discussion in section 5. Finally, in section 6 we summarise our key points.

## 2. Related research – a changing 'World of Standards'

Standardisation of mobile content services is largely absent from the research literature. There is, however, one important exception: Funk's (2001) research on i-mode. Since i-mode is a proprietary platform, and we focus on CPA as an open standard, we will, based on Funk's work, make a careful comparison of these two approaches in section 5.

Because of the growing significance of mobile communication technology, some research has been done on the definition and establishment of mobile communication standards like NMT, GSM, UMTS, etc. (for example Fomin 2001; Keil 2002; Manninen 2002). The major focus of these studies has been on historical accounts, as written in committee minutes, technical documentation and specifications, and as recollected by committee members. Standardisation has been conceptualised as the manner in which different standards are selected, how formal standardisation organisations supports this process and how economically and socially optimal standards can (or cannot) be stimulated by way of organising and regulation. Thus, the focus has primarily been on formal standardisation processes and the resulting output of standards as technical specifications. The research presented in this paper is part of a growing interest in research on standardisation in general and standardisation within ICT in particular. This increasing

interest is a result of the growth in the number and importance of standards as well as the transformation of the 'world of standards' that is a part of the so-called convergence of telecommunications and information technologies (Brunsson and Jacobsson 2002). Standardisation of mobile content services is among the newcomers in this 'world'. Thus, this research aims at disclosing the transformations and the challenges they raise for future standardisation, and suggesting proposals for how to deal with these challenges.

The number of standards has increased substantially, and so have the links between them (Brunsson and Jacobsson 2002; Romer 1990; Schmidt and Werle 1998). Technological changes within telecommunications and ICT have brought many new actors into this field. Telecommunication standardisation used to be taken care of by (a limited number of) service providers and equipment manufacturers. With the digitalisation of telecom, computer manufacturers and software companies also got involved. This technological change opened up possibilities for a broad range of new services. The development of such services involved even more actors – even users (big and small companies, professionals like medical doctors, etc.) (Jakobs 2000). Such services also implied a need for new kinds of standards which raised new challenges. Some new and hard challenges were related to the fact that the standards for high level services needed to satisfy much more complex user practices (in particular compared to the simple ones supported by traditional telecommunications which just enabled users to dial a number, talk, and hang up.) (Bowker and Star 1999; Foray 1994; Hanseth and Monteiro 1997; Jakobs 2000). The ongoing 'convergence' of the ICT and the media sectors further increases this technological and institutional complexity and variety as well as increases the speed of change.

These changes partly triggered, and were partly taking place in parallel, with the deregulation of the telecommunication sector. The deregulation increased competition, which again brought more actors into the picture at the same time as it changed the relations between the actors involved and accordingly the rules of the standardisation process. The rules of the game were also changed as a consequence of the convergence of the ICT and the media sectors which implied that the borderlines between the regulatory

regimens within these sectors (telecommunication, TV broadcasting, printed press, etc.) became blurred (see for instance, Antonelli 1994; Brunsson and Jacobsson 2002; Bunduchi et al. 2005a; Bunduchi et al. 2005b; Bunduchi et al. 2004; David and Shurmer 1996; David and Steinmueller 1994; Mattli 2001; Werle 2001; Williams et al. 2004)

### 2.1.    Standardisation processes and flexibility

Since early industrialisation, *ad hoc* approaches to standardisation have been replaced with formal and dedicated standards development organisations (SDO) (Lehr 1992). The aim of a SDO is to provide an institutional arena to support consensus building, ruling out heterogeneous interests thereby avoiding the development of suboptimal standards (Tassey 1995). To a varying degree, standardisation processes need the support of SDOs. The emerging context of standardisation in telecom requires flexible standardisation processes. All changes mentioned above makes the tasks of standardisation bodies different. In very many cases, the traditional SDOs are too slow, bureaucratic, and inflexible – the number and varieties of the technology and actors involved constitutes a too complex and rapidly changing environment for traditional SDOs. SDOs have historically limited their participants to engineers and non-technical issues are not on the agenda, as described in depth by Haug (2002) and Manninen (2002) in the case of the standardisation of GSM. As an implication, SDOs are not suited for standardising complete technological systems. One initiative to meet this limitation is made by several consortiums or forums, such as the UMTS Forum, by coordinating the implementation of standards in the marketplace by rapidly exploiting commercial possibilities (Hawkins 1999; Vercoulen and Weberg 1998). The interest of the participants in a consortium is thus primarily strategic positioning in the market.

Standardisation within telecommunications differs substantially from standardisation within the computer industry related to, for example, vertical or horizontal integration and formal documentation or experimental driven processes (Branscomb and Kahin 1996). While dissimilarities in organisational styles

and standardisation experiences are challenging (David and Shurmer 1996), the dynamics in the community will also require an equally dynamic standardisation architecture. With the ICT of today, a range of decisions have to be made amongst a range of different actors who expect to be involved in standardisation. They come from different industries with different understanding and approaches to standardisation as well as developing technology in general. To support standardisation within this context, the combination of SDOs and consortiums as a hybrid approach have been suggested (Shapiro et al. 2001).

## 2.2. Standards and flexibility

Standardised systems such as ICTs tend to become accumulatively change resistant as they grow and diffuse (Egyedi 2002; Hanseth et al. 1996). Thus, to endure, these systems have to be prepared for change to avoid becoming obsolete (Tassey 2000). Standards must allow for growth and change through various means of flexibility to avoid this. Flexibility can be obtained by standardised interfaces, decomposition, modularisation and black-boxing, allowing some components to be kept stable while others are changed without implications for the rest of the system. Allowing for peripheral change and innovation can release a significant potential for increasing the size of the system, its market as well as the diversity of services (David 2001; Lessig 2001).

The location of functions close to the application that uses the function, the so-called end-to-end argument, is one example of providing flexibility by systems design (Saltzer et al. 1984). The point this argument is making is that functionality in communication networks only can be appropriately implemented if based on knowledge that only exists close to the applications standing at the endpoints of a communication system. Thus, the network should not control how it grows, the applications should. Both Lessig (2001) and David (David 2005) exemplifies this argument by illustrating the Internet as a network where intelligence is in the fringes. Since the network is not optimised for any application but open for and

inviting the unexpected and surprising, innovations can flourish without changes in standards. While standards nurture and sometimes are the very preconditions for innovation, the interrelationship between innovation and standards is intricate. Standards may for instance result in future innovations being hampered by previous innovations which now are standardised (Dunphy et al. 1996). Because of an increasing installed base, not only does the cost of switching and changing standards become higher but innovations are required to conform to existing standards.

### 2.3. Open standards

Those who provide an open, stable and standardised infrastructure have to rely on risk-willing innovators to eagerly apply and use their standard. In exchange for fully controlling the technology, they promote a larger and probably longer lasting market (Tassey 1995). Standards are not only essential for interoperability, but also settle whether, where and how to open, limit or discourage flexibility. Openness is thus not binary, and standards play a crucial role in initiating innovation as well as maintaining existing relationships between organisations, distributing roles, value chains etc.

There are various meanings attached to and definitions of open standards (Shapiro and Varian 1999). One way of defining open standards is that their specification is publicly available (Funk 1998; Funk and Methe 2001). Indiscriminately allowing anyone to obtain and use the standard facilitates interoperability, such as in the case of GSM and its predecessor NMT (Funk and Methe 2001). As a result, open standards are easier to accept and more likely to attract support by other firms (Funk and Methe 2001). In addition, open standards avoid the creation of lock-ins to certain actors. But openness in terms of the availability of specifications can come with a hybrid approach where the strategy is to achieve returns by only opening parts of the standard and disclosing the standard under restrictions, which makes it difficult both practically and economically to be deployed by others (West 2003). In addition to the availability of specifications and

this political dimension are also more pragmatic issues related to the openness of standards, such as for example the availability of reference implementations to assure interoperability.

The theoretical perspectives presented here underscore the significance of open standards and standardisation processes related to flexibility and innovation. At the same time, the case of CPA presented in this paper shows some prominent differences compared to previous conceptualisations of standards and standardisation. While the call for flexibility is obvious in the context of mobile content services, the degree of flexibility and how to implement it is a more complex matter. Being highly dynamic and involving a range of actors, standardisation appears as rather technically simple but organisationally complex. SDOs and consortia have had no role in the process which has been based on *ad hoc*, local and informal initiatives to coordinate the development of the standard. We thus conceptualise open standards as more than technical specifications produced by SDOs, and to include the range of arrangements necessary to create interoperability and make things work.

## 3. Research methodology

Standards are widely accepted as being of strategic value, thus standards develop through a process where multiple actors pursue their strategies and agendas. Our research approach is based on an understanding of the processes of standard making as being open and situated as well as being understood differently by the various actors involved. Inspired by Star (Star 1999), our 'reading' of how CPA emerged was focused on identifying and analysing different perspectives as well as the more unstructured and invisible work involved. While CPA is usually presented by network operators as their 'success story', our approach revealed a highly complex process that was not primarily network operator driven. Further insights were gained into local contingencies, the properties of the standard and the achievements of those engaged in developing the standard.

The research presented here started in 2002 and continued until late 2004. As we were involved in a larger project studying various attempts of internationalising platforms within one of the Norwegian network operators, the case of CPA seemed to be of particular interest. Early discussions with people working with CPA directed our attention to various properties of CPA and challenges related to its standardisation, implementation and operation. To understand these issues better, one of the authors initiated an in-depth study of the standard. Since CPA appeared as inseparable with its context, a case study approach was adopted (Yin 1994), following an interpretative perspective (Klein and Myers 1999; Orlikowski and Baroudi 1991; Walsham 1993; Walsham 1995). We found our role as researchers to involve describing, interpreting, analysing and understanding the social world of these actors (Klein and Myers 1999; Orlikowski and Baroudi 1991).

Starting out by interviewing the manager of CPA within the network operator where we were involved directed our attention to how close the standard was interrelated with other (internal) technical platforms as well as actors within the business sector. We also found the appearance of the relationship between the various actors and their coordination interesting which guided us also to study how CPA was initially conceived and implemented. Thus, to understand the standard, the study reached both back in time towards the predecessors of CPA, out into the business sector as well as out into the more 'global' setting by studying the internationalisation attempts.

A total of 39 formal interviews were conducted with managers, heads of sales and system developers in a total of 23 different organisations, official of government agencies and forums (listed in Table 1), including the two Norwegian network operators. The hierarchical and professional positions of the interviewees are not listed here. The interviews lasted typically 45 minutes to an hour; they were all recorded, transcribed and notes were taken, but the interviews did not follow a strict interview guide. All interviews were focused on discussing the very nature of CPA, its development and operation. As the interviews progressed, certain issues were also identified and focused on. In addition to the interviews, data was also collected from

studying standard documents and specifications, websites and the trade press. In addition, our

'comparative' data about the i-mode standard was based on research literature as well as annual reports.

**Table 1 Interviews**

| Type organisation | No. interviews |
|---|---|
| Network operator | 18 |
| Aggregator | 6 |
| Small content provider | 5 |
| Integrator | 2 |
| Forum/consortia | 2 |
| Government | 4 |
| Content producers | 2 |
| Total | 39 |

While giving a broad understanding of the standard as well as its context, this approach came with certain

challenges. Since we did not operate within the borders of one or a few organisations, we had to negotiate

access and justify the participation of the interviewees in a variety of different organisations, ranging from 5-

men businesses to network operators with 20,000 employees. While this required different approaches to

gain access, maintaining access to all these organisations was not feasible. Another challenge was to

identify the important actors related to CPA, both historically and related to the business sector. To access

these 'hard-to-reach' populations, a snowball strategy (Vogt 1999) was used.

The data analysis was interpretive and based on our capacity to conceptualise the essential topics in

our data. In our analysis, we broadly focused on the industry's market structure, the nature of the services

and the standard to include a broad context of influential factors as the actors' aims, institutions and

organisations and their strategies. During the transcription of the interviews, the key themes were identified.

The themes subsequently acted as input to discussions and guided the further analysis of the transcripts as

well as the topic for new interviews. In parallel with this, the research has been guided by presentations and

discussions at several seminars, workshops and conferences.

## 4. The CPA standard

In this section we outline the Norwegian CPA standard, its process of establishment and the actors involved. We put a particular emphasis on what we see as distinct with CPA related to common standards and standardisation approaches within telecommunications.

### 4.1. The standard

The CPA standard basically supports three tasks:

- production, preparation and marketing of content services;

- transportation (requests and deliveries) of services between producers and consumers; and

- handling the involved billing transactions.

This service sector was up until 1999 based on the network operators playing all these roles. The introduction of CPA broke up this vertical integration into functional domains, enabling and requiring a range of new roles and actors. The provision of rather simple services, such as ringtones for mobile phones will in the case of CPA usually involve:

- content producers (composers represented by IPR-brokers);

- content providers (preparing compositions for mobile phones);

- aggregators collecting a rich variety of content and possibly integrating these in larger service concepts;

- media windows (i.e. newspapers, magazines, TV-broadcasters, etc.) providing space for marketing; and

- network operators providing transportation and billing services.

Linked to the core of its business idea, CPA is a joint undertaking by both the Norwegian mobile network operators. On the one hand, they provide a common service level, but not a single technical interface towards content providers/aggregators. On the other, they provide a common user interface for content service consumers. Based on this standardised approach, CPA is a public and market wide standard for

any mobile phone subscriber in Norway. CPA enables the consumers to acquire content services through some simple steps. For example, if a consumer would like to travel with public transport from address A to B in Oslo, he first locates the required information for ordering the service. Typically, this information is available on the web, in a magazine, but most importantly close to where it is supposed to be consumed, such as on a poster at a subway station. The information required is basically a short number (four digit phone number) from where to order the service from and the syntax for the service request. The subscriber requests the content by sending a simple SMS (Short Message Services) from his mobile phone - containing in this case for example "from A to B" to the number 2003 (step 1 in Figure 1).

A key element of CPA is that service usage is billed over the regular mobile phone bill. Since the consumer is already registered with one of the network operators, there is thus no need for cumbersome registration and confirmation of personal data, credit card number etc. When the network operator to which the consumer subscribe receives the SMS at its SMSC (message centre), the number 2003 is recognised and the request as well as the subscriber' phone number is sent to the CPA platform (step 2). The CPA platform forwards the request to the appropriate content provider over a TCP/IP connection (step 3).
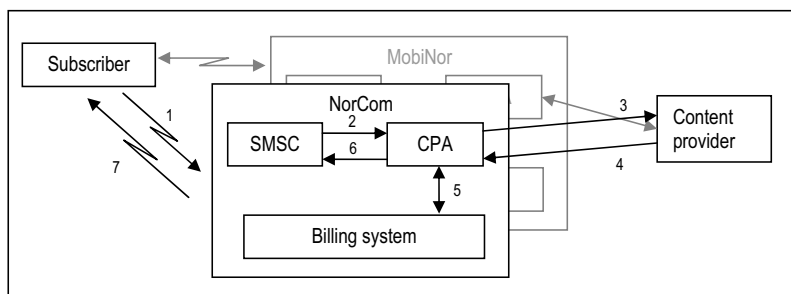


**Figure 1 Content services transactions on the CPA**

When the content provider receives the request, they recognise "from A to B", and produce and return the requested content back to the network operator together with the phone number of the requester. In addition, the content provider also specifies the rating class of the service, i.e. the cost which the consumer is to be charged. It is thus the content provider and not the network operators who specify the cost,

according to standardised rating classes ranging from 1 to 60 Norwegian Kroner (NOK) (step 4). The network operator requests their billing system with a CDR (Call Data Record) to handle the request according to the rating class (step 5), and if successful, the content is delivered to the customer by SMS over the SMSC (step 6 and 7). Finally, when the subscriber pays his mobile phone bill, the revenue is split based on standardised sharing model between the network operator and the content provider. The content of these transactions are not monitored by the network operators. However, it is to their discretion to react to complaints and close down services they find inappropriate or not following their guidelines.

One prominent aspect with the CPA standard is that it enables premium mobile terminated billing. This means that incoming messages, that is the request for services, are charged as basic SMS messages according to the calling plan of the consumer, while the return message originating from the content provider (step 4 in figure 1) is premium rated, i.e. charges the receiver for more than the cost of a regular SMS. Giving the content providers the possibility to charge several times for one request, this further enables subscription or push services as well as services that are requested from other sources than an SMS, in particular the Internet. For example, based on choosing a certain geographical area or destination, ski-enthusiasts can subscribe to alarm services which are triggered with an SMS whenever there is more than 20 cm fresh snow (powder-alarm). Usually, subscribing to such services is for free, but each alert triggered SMS is charged according to a certain rate. Initiating such a service subscription may be based on preferences registered via the web, rather than using a simple, but cumbersome SMS for such purposes.

The emergence of CPA was primarily a result of the efforts of the network operators, but their recent efforts have been modest and catered primarily to increasing traffic. At the same time, several application houses are active in building add-ons to the underlying infrastructure of the CPA standard to enable new services and service concepts. One example is software to collect votes, produce and visually present

numbers and statistics on ballots in relation to TV-shows, as well as software which presents on-screen comments and questions posted by SMS to discussions/talk-shows.

While standards in mobile telecommunication primarily are technical specifications produced by formal and international standardisation organisations, CPA is of a different kind. While being interrelated with a range of technical standards such as GSM, SMS, WAP and MMS, CPA is primarily based on more flexible, loose and informal agreements which are necessary to coordinate the various actors' efforts. And what we here consider the CPA standard to be is more than just technical specifications – it is a 'standardised package' (Fujimura 1992) that includes components of very different kinds.

CPA is based on the network operators providing a standardised *business model* for premium rated content services to the content providers. By standard (and non-negotiable) revenue sharing models and agreements the content providers are offered public market access as well as economies of scale in billing. The maximum charge is 60 NOK (app Euro 7.50) and the predefined revenue split favours the network operator from 54 to 29 percent. The content providers are offered basically the same functionally and service level, even if the interfaces to the network operators' implementation of CPA platforms differs. The service level provided by the network operators are standardised in the sense that the infrastructure of each of the network operators can take care of general services as well as the typical traffic peaks. The services are provided by means of an infrastructure based on a common architecture. This infrastructure is, however, implemented differently by the different network operators. While one uses the CIMD protocol, which is a subset of Nokia's CIMD2 with additional operator specific parameters, the other has implemented a SonicMQ client API towards the content providers. The content providers are thus required to implement a TCP/IP interface, as well as a Java-client, alternatively a C-client. Both interfaces are based on content providers initiating a TCP/IP connection to the respective CPA platforms. The basic transactions are service requests originating from the subscriber, messages containing the services originating from the content provider, as well as acknowledge/error messages from the CPA platform to the content providers.

However, aggregators provide interfaces which hide the differences between the operators' implementations of CPA for the majority of the content providers. This reduces time-to-market and the necessity of substantial up-front investments to connect to CPA. Further, it also lessens the administrative burden of network operators as smaller content providers find it appropriate to connect through the aggregators. Based on their public market approach, network operators have also standardised their administration and use of *short numbers and rating classes*. This adds to the transparency of the market by being the basis for a standardised way of marketing the services. Further, in order to reduce the risk of 'offensive' services being provided and marketed or marketed fallaciously, the network operators have standardised guidelines describing *which services* cannot be provided over CPA as well as *how to market the services* in a consumer friendly manner.

By providing a standardised *interface for service acquisition* – the user interface, every mobile phone user in Norway has easy and transparent access to content services. Independent of which operator they subscribe to as well as the type of subscription and calling plan, subscribers can access the same services, from the same short number and for the same price. This also makes the marketing of services simpler and thus easier to read for consumers. The items that are standardised related to CPA are summarised in Table 2 below.

**Table 2 What is standardised related to CPA**

| |
|---|
| Business model and revenue sharing model |
| Equivalent functionality, architecture and service level for content providers |
| Administration and use of rating classes and short numbers |
| Guidelines for consumer protection |
| Interface for service acquisition |

### 4.2. The emergence of the standard

We will now describe the process (design, implementation and adoption) leading up to the CPA standard. While focusing on the efforts of the two Norwegian mobile network operators, we will also show the important role of other actors.

In 1997, both of the Norwegian mobile network operators launched independent platforms for provision of exclusive content and utility-based SMS services to their respective subscribers. The services were typically national news, stock quotes, weather forecasts and yellow pages. The content services were rated regardless of content and were charged simply on a per transaction basis as regular SMS. The stake of the content providers involved was primarily to extend the reach of their services as well as relate their brand to new and innovative technology. While this made the services cheap for consumers (NOK 3) it offered limited possibilities for making profit. The network operators' pursuit of branded and exclusive services for differentiation purposes further inhibited and limited the richness of the services offer (only utility services). The market did not respond positively and no further service development and innovation was spurred.

In spite of the limited success of the services, some enthusiasts persistently believed and argued that mobile content services had the potential of becoming a big future business segment. During fall 1999 one of them, a former employee of one of the network operators returned after working for a TV broadcaster for a few years. Based on his experiences with the existing SMS services, he started pursuing a more rewarding and dynamic approach. He immediately engaged in making it possible for aggregators to operate between content providers and network operators, i.e. to compete with the network operators service offers. At this time, other representatives for the content providers also approached both network operators with similar ideas. However, the network operators where difficult to deal with, and did not take suggestions such as to charge 5 and 10 NOK for content services seriously, but where rather laughing, as commented by a product developer from one of the TV broadcasters:

> *"So, we felt for a long time like banging our heads to the door there, and this was not because of technical issues, because that was the next thing, then one had to build that in addition. The problem was that they simply did not believe that it was possible to create revenues from it".*

On the basis of these initiatives from the content providers, the lack of success with the previous platforms, high cost for marketing, fundamental concerns related to linking their brand to non-utility services as well as

the pricing policy, the network operators took new initiatives. The management efforts and the investment in the further implementation of what was becoming the CPA were, however, limited. The initiatives were all taken by a few enthusiastic and persistent individuals. They managed to find some space for action even if this was more in conflict with than supported by existing strategies - as noted by the 'manager' of the CPA 'project' within one the network operators:

> *"It was a bit of entrepreneurship spirited, the project, because we had no resources assigned like you are used to in a big company. So we had to make everything ourselves, and find the resources ourselves, in a form of a project. And this resulted in, that the atmosphere, both market wise and business wise and the technical development was entrepreneur directed."*

After trying for months to get the access based on rumours regarding a new platform, and initially being rejected, the first content provider finally got the access to the CPA platform of one of the network operators in the fall 2000. The CPA platform was at this point only based on minor technical changes in the existing SMS service platform, and it was clear that the platform was premature and still controversial for network operators, as noted by the manager of the content provider:

> *"And then they had something running … and suddenly I showed up, but they had not planned to launch at this early stage. And they had to sort out, what do we do now? And that is difficult in this kind of an organisation. So, finally by being persistent, I could plug into the platform, but it was made clear that the billing could fail to function at any time and without any rights for me to claim compensation … John[1] [an employee a network operator] meant a lot for this, he did a lot that he was not allowed to by his manager. He pushed this trough internally, in a way that he possible would not if he were a devoted and nervous guy. So he was scolded a lot in the beginning."*

To develop the CPA standard, negotiation and coordination were also initiated among the network operators. The coordination was based on sorting out issues such as the usage of common short numbers

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[1] Not the actual name

to attract large media actors. In addition, common price intervals (rating classes) were introduced to enable marketing and one number and one price for services across the market. While coordinating, the need for a standard, at least related to the service level, was identified. The network operators were focused on avoiding the development of interfaces that were too different towards the content providers. While a certain difference in the interfaces could be positive since it would make it less attractive for small content providers to connect directly to CPA (with increasing administrative costs), too much difference could lead to only one, strong aggregator controlling the content market, which should be avoided.

Bearing in mind the limitations with earlier 'walled garden' approaches, there is consent in the Norwegian market that the CPA standard was crucial for this industry. While the initiatives behind introducing the standard came from content providers, the very shape of the standard was at the same time defined by the network operators. For example, the revenue model has been a contagious matter between network operators and the rest of the industry. This tension is intensified by the lack of initiative and resources put into developing CPA further by the network operators. While the division of roles and responsibilities is seen as appropriate, this is not reflected in the distribution of burdens and benefits. Defining the shape of the CPA standard, the constellation of network operators have also created a monopoly situation in the sense that the revenue share models are non-negotiable and there are no alternative equivalent channels for content services. Attempts by external actors to implement competing 'CPA' platforms in the mobile networks have been turned down by the network operators.

To summarise, the developers and the promoters of CPA were operating with scarce resources but were equipped with the ability to pursue what they called a 'non-telecommunication' like approach. More particularly, they avoided the need for a strong and convincing 'business case', the costs of the usual grand marketing campaigns of the network operators, the need to cumbersomely change the billing system and they managed to postpone technical systematisation and documentation. While the network operators implemented technical CPA platforms, content providers were similarly important in their persistent belief

and pursuit for its realisation. In this process, aggregators found their role in providing support for smaller content providers where the standard did not suffice. In addition, and perhaps more important, they developed and introduced add-ons and extensions to the platform, enabling new services and service concepts.  At least partially resulting from these circumstances, the cost of implementing and operating CPA platforms was marginal for the network operators compared to earlier initiatives. The costs and further the risks involved are now primarily resting with the content providers together with increased flexibility for service innovation.

### 4.3. Actors and institutions in the standardisation process

We will now turn to the organisation of the standardisation process: which actors were involved and what kind of 'standardisation bodies' they established to help coordinate the work. We use here the term 'standardisation body', but it is worth noting that none of those we will mention were of the traditional kind with formal rules and formally established working groups, etc.

The Norwegian mobile telecommunication market is relatively tidy and basically composed of two network operators and 21 mobile virtual network operators (MVNOs). In turnover, the operators have respectively 55 and 29 percent of the market. Related to CPA, the industry is much more complex and involves a range of different roles and actors as illustrated in Table 3. The main activities related to CPA involve approximately 50 different companies and 250 employees.

The role of aggregators is to collect content from a variety of content providers and provide it in the market. Managing the relationships and interfaces with the network operators, aggregators decrease the time to market and leverage the up-front costs for small content providers (currently 200.000 NOK). Media windows are departments of media houses and TV-broadcasters which offer marketing space for content providers and aggregators. Application houses and integrators specialise in developing gateways to the

network operators as well as new service concepts. Finally, the content providers are producing (from scratch or based on others' content) and providing the content services.

Table 3 Actors involved in the Norwegian CPA market

| Type of actors | Number of |
|---|---|
| Network operators | 2 |
| Aggregators (large) | 5 |
| Media windows | 6 |
| Application houses and integrators | 14 |
| Content providers | 153 |

To coordinate between the different actors in the case of CPA, several bodies have developed over time. Coordination is primarily ongoing between the network operators and the content providers as well as between these groups.

The development and establishment of CPA did not involve any traditional SDOs. In one way, several activities were coordinated by the market. But institutional structures beyond the market did play important roles as most of the discussions were taking place through informal networks. This was possible because the number of people involved was low and people knew each other rather well. Relationships had developed through collaboration and because people moved around among the organisations. For example, several of those who initially developed CPA are now working for application houses and integrators as well as being managers of the aggregators. Another example is the one who initiated the development of CPA within one of the network operators, who did that explicitly based on experiences from working with a content provider and media window. This person is now head of one of the application houses. The fist version of the CPA was developed by a few people within the network operators after a few key people had agreed upon the approach. On the one hand, they agreed to follow this approach because of extensive knowledge about the needs of the content providers due to own experiences in the content industry as well as inputs from pro-active and persistent content providers. On the other hand, they also believed that management would not allocate resources to do anything more sophisticated.

After the development of the first version of the platform, most standardisation work has been organised as *ad hoc* projects going across various organisations and types of actors. Most projects have been initiated by content providers that need new functionality. They have approached aggregators and discussed the detailed specifications of the new functions and how to implement them. And in most cases the aggregators have implemented and added to the 'ends' of the platform, i.e. the parts operated by the content providers themselves. But in some cases, the new functions have required extensions to the platforms operated by the network operators. This happened, for instance, when the service levels had to be improved to handle traffic peaks related to TV-shows such as "Big Brother" and "Idol" as well as the introduction of MMS services.

Most actors are represented in the organisation 'Teleforum'. Within the framework of this organisation the actors have agreed upon a set of rules for consumer protection related to CPA, for instance what kind of content they should not allow, treatment of customers including dealing with customers complains, etc. A main motivation behind the way this forum has worked has been the fact that all actors agreed early to act cautiously so that the public authorities did not see any need for more formal regulation of this sector. They believed that such formal regulation would make things more difficult and slow down the growth and development of this sector. The content providers have also established an organisation called 'Innholdsnett'[2]. Within this organisation they discuss various issues of shared interest. This includes discussions to help understand the market, the architecture of CPA and the possibilities within. Both 'Teleforum' and 'Innholdsnett' have thus played a role in informing the market about the CPA standard besides the operators.

### 4.4.  CPA in other countries

In this section, we illustrate how CPA is interrelated with the context it is implemented in. Based on interviews with people from one of the network operators engaged in internationalising their CPA platform

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[2] A Norwegian word for 'Content network'

across its internationally dispersed affiliates, we point out three important contextual issues. The status of CPA in the different affiliates reveals large variations, and 'success' is still only to be found in Malaysia.

Firstly, pursuing an 'open garden' approach does not necessarily come as an ordinary approach for network operators. Even in the case of Norway, the network operators experience an ambivalent position. Exclusive provision of services is seen as retaining customers which indeed is a crucial measure. Thus, network operators may find keeping control as well as their independence from the content industry as strategically more important than nurturing what is for them a rather marginal content industry.

Secondly, to allow the content providers the flexibility to add new services and rate them independently, it is required that mobile terminated billing is implemented across the network operators. Historically, network operators have had the sole responsibility to calculate the cost of service usage. Some operators still find it most appropriate to continue with this approach. Equally important, mobile terminated billing does not allow for subscription services such as the "powder-alarm" described above, limiting the diversity of services. While changing from conventional mobile originated billing may not be a technical challenge, it will however induce costs for the network operators. In addition, certain national regulatory regimes do not allow for mobile terminated billing as to enforce consumer protection.

Thirdly, a standard like CPA needs to work properly to be accepted and established jointly by the actors in the market. This depends on the existing relationship between the actors. Some of the affiliates operate in markets where the network operators have a long and fruitful history of interconnection and coordination, while others operate in markets with strong mistrust. In some countries, coordination among network operators is problematic, but has been spurred by TV-broadcasters and certain TV-shows. But at the same time, no agreement to form a permanent standard has been made. At the same time, pro-active and hesitant content providers, aggregators and application houses are rare. It seems as if the informal interaction and glue between network operators and their larger context is not present to enable and support further coordination and developments.

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These examples underscore that CPA has to be discussed, negotiated and accepted as a common approach throughout the market. The very nature of CPA draws upon a complex network of actors and technologies. Understanding the importance of building on what already exists in a modest fashion; through nurturing the installed base of technical components, social relationships as well as external actors is vital.

## 5. Discussion

In this section we will start by comparing CPA with other Norwegian 'walled garden' approaches as well as the well known i-mode standard in Japan. Illustrating why CPA has been more successful than 'walled garden' approaches in the Norwegian context, we continue by discussing how and why CPA came into being.

### 5.1. CPA and alternative platforms

The users' acceptance of NTT DoCoMo's i-mode has been found remarkably high, and i-mode has been identified as a unique success case incomparable to other mobile content services (MacDonald 2003). Our analysis shows that i-mode is not unique, and Norwegian network operators have since 1997 followed similar proprietary approaches. In this section we will discuss how CPA differs from these approaches and illustrate when and why a CPA approach is to be preferred.

In 1997, both the Norwegian mobile phone operators launched proprietary content service platforms based on exclusive agreements with content providers. For example, one operator has the exclusive right to provide logos, ringtones, games etc. based on Disney characters (from Walt Disney Internet Group), while the other provide advanced weather forecasts for their subscribers in cooperation with The Norwegian Meteorological Institute. The network operators have continued these 'walled garden' approaches in parallel with providing CPA. Similarly, i-mode offers a range of services of which the most popular are travelling information, SMS equivalent e-mail services, weather and news, music, games and entertainment (Ishii 2004). When it comes to penetration rate and the number of users, the story is quite

different for CPA. While CPA services are accessible throughout the market, the Norwegian 'walled garden' approaches and the mobile internet in Japan are more limited. In Japan, the services are in general (including the competing standards Sky web and EZ-web) available for 36 percent of the total population (Ishii 2004). In the case of CPA, the penetration of CPA is following the mobile phone penetration which is currently at 102 percent. While 82 percent of the mobile phone users subscribed to mobile internet services in Japan, only 53 percent of the mobile phone users actually use the services. i-mode users also have to register for the service and have a certain i-mode phone, which is not the case for the Norwegian 'walled garden' approaches.

While CPA has had little strategic value, i-mode and the Norwegian 'walled garden' approaches are based on using content services for strategic purposes. Where CPA is public and transparent across mobile networks, the alternative approaches are used by network operators for differentiation purposes to attract and retain mobile phone users. Because of strategic importance, the network operators are willing to spend more resources on 'walled garden' approaches. At the same time, centralised approaches involve larger expenses on their side related to service development, marketing and administration. Where CPA delegates the responsibility and the related costs of designing, introducing and administering services to other actors in the market, NTT does not only take editorial responsibility, but has also introduced a large bureaucratic organisation to administer their service portfolio.

Changes and extensions to the 'walled garden' platforms is the responsibility of the network operators, and where innovation is pursued by content providers it is under their scrutiny. Only if a new service fits the service portfolio of the network operator and has the potential to create revenue, is it accepted. In the case of CPA, anyone with a registered short number can add new components and services on the fly. Thus, where 'walled garden' approaches leave the network operators with considerable risk, CPA redistributes most of the risk among a large number of other actors. The 'walled garden' approaches by the Norwegian network operators have been problematic in several ways. On the one hand, marketing is expensive for

network operators without a media window, and due to limited revenue, such expenses are hard to legitimise. Only providing services to a portion of the market makes this even more problematic. On the other, the network operators are given strong national and public responsibility This is especially the case for the previous monopolist and still partly state owned operator. As a consequence, services such as cocktail recipes on SMS have been too controversial due to public scrutiny, which strictly limits the service portfolio. This indicates the network operators are not necessarily those who should provide services directly.

Even if i-mode and the Norwegian 'walled garden' approaches create revenue, they poses limitations on innovation and the development of content services in general. When both restricting the access for users and the possibility to introduce new services, they will at best only be providing compliant services for a limited user population. In an immature market, CPA creates a context which invites for innovation and diversity. This will, at least over time, prove to provide a wider range of services than 'walled garden' approaches. In comparison, only a handful of the several hundreds of content providers seeking a partnership with NTT DoCoMo each month are accepted. While this process increases the time-to-market for new services, NTT DoCoMo more importantly more or less determines who can enter the industry and who cannot (Funk 2001).

### 5.2.    Why did CPA emerge as a standard in Norway?

We will now inquire into the question of *why* CPA happened to take the shape it has. The fact that open standards are important in telecommunication is indeed old news. The more relevant question, then, is: *why and how was an open standard developed in Norway?* An answer to this question will hopefully tell us something about what needs to be done in other countries to facilitate the emergence of similar open standards. Some of the key factors behind the successful establishment of the CPA standard can be summarised as follows:

Firstly, the network operators went for an 'open garden' approach. The operators controlling the infrastructure are key players in this field; accordingly their strategies are crucial for the final outcome. And the dominating picture is that the operators try to build their integrated and closed platforms, just like i-mode. What was different in Norway was, first of all, that the operators did *not* see mobile content services as strategic. Accordingly, they did not want to put much money into it, which a powerful closed platform requires. The management's pessimism regarding future revenue from this sector and the acceptance of the low profile 'open garden' approach was largely based on the lacking revenues from previous platforms and lack of risk-willingness, particularly relating the network operators' brand to controversial services. In this context, they did not hinder a few enthusiasts to take their own initiatives. Since management did not attribute significance to content services, these people could only make achievements through *ad hoc* and *bottom-up* initiatives which required close *collaboration* with other actors in this market.

Secondly, succeeding content platforms had already created and involved a range of small content providers and software companies. Continuously seeking new outlets for their relatively simple services, they had a shared interest in an open platform to get easy access to the largest possible market. Accordingly, they pushed for standards like CPA. At the same time, these small companies have been persistent with their beliefs in and expectations of a growing market. In fact, because of the 'hands-off' attitude of the network operators, these small companies have been those pushing and coordinating the overall activities. And among these actors, in particular the content providers, there is limited competition. Accordingly, their relations were dominated by their strong shared interests in an open standard. Thus, reaching shared agreements was much easier when the operators were sitting in the back seat.

Thirdly, the limited size of the Norwegian market, the relatively weak historical relationship between network operators and the content industry, and previous failures to monopolise this market by means of a closed platform, called for a different approach. While there is fierce competition between network operators in general, on the operational level there are strong linkages across this market based on

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personal relationships. Through this network, coordination as well as the development of shared basic ideas, visions and values have been possible.

Fourthly, the range of small organisations involved with CPA has in general been short on resources. Thus, there has been a demand for a platform to make it as cheap and easy as possible to introduce new services or extensions of exiting ones. This chase for short-term profits created short feedback loops from the market regarding both what kind of services the users were willing to pay for as well as which requirements to the platform these generated. The lack of resources and short term focus also implied that the simplest possible solutions were developed – solutions that were easy to change as new requirements were uncovered.

Fifthly, the development and the operation of the CPA standard has involved people from a relatively small community. Not only knowing each other, but also having the experience of working for different organisations involved with mobile content services has resulted in relatively common and shared visions. This enabled smooth collaboration and coordination among those involved, including setting up *ad hoc* 'standardisation bodies' to discuss and solve issues requiring common solutions. In sum, CPA unfolded in an open context which allowed for intra-organisational collaboration, bottom-up initiatives, changing roles as well as rapid changes in the standard.

### 5.3. The important characteristics of the standard

The success of the CPA standard in Norway can be attributed to its very characteristics: openness, completeness, simplicity, informality, flexibility, robustness and building on the installed base. We will here briefly discuss each of these points. The standard was based on an *open platform*. Not only can anybody connect to the platform, but they can also extend it by adding new functions at the ends and thus extend the existing architecture without changing what exists. Thus the *architecture* is also open. At the same time, the *standardisation process* has been open for those with the initiative to participate. This characteristic is a

crucial precondition for enabling innovative activities related to content services. At the same time, changes have also been curbed by network operators hampering attempts to implement alternative billing solutions. The standard was *complete* in the sense that it covered all aspects that the actors needed to agree on. This included the more technical issues such as the overall functionality and the service level of the network operators' platforms. But just as important, it also covered issues like marketing, use of short numbers, rating classes, etc. And implicitly, the standard also defined roles for the various actors, such as the aggregators and integrators. The standard was also very *simple*. Only the minimum of functionality was included. This means that it easy to understand and to use or implement, and it is cheap and easy to provide new services based on it. And most important, it is easy to change when new requirements are revealed. The standard is also *informal* by being incomplete, which means that almost none of its features are specified formally or in detail. What was specified was the platforms overall functionality. This characteristic is the opposite of what is commonly seen as a crucial requirement of a standard. That is that if two independent implementations of a standard are both correct, they should interoperate perfectly. The reality, however, is different. No matter how detailed a standard is specified, there are always holes in it that those implementing the standard need to agree upon. In the CPA case, this fact was not seen as an anomaly, but as an important feature that was taken advantage of. The problems a technically complete standard is supposed to solve is in the CPA case solved by organisational means rather than technological in the sense that unified interfaces to the operators are provided by the integrators. This has been an advantage because:

- Specifying a technically complete standard would require lots of hard work which again would demand resources which were not present.
- This work would be organisationally complex because of the heterogeneity of the actors' involved (small and big ones, new and old, rich and poor, coming for various business sectors, etc.). The

competition and rivalry between the network operators would make it hard for them to agree upon a detailed specification.

- A more formally specified standard would normally be expected to solve future needs. What the future needs are in this area is incredibly hard to predict. Different actors would have very different ideas about that, and accordingly they would have very different ideas about what the requirements for a standard should be, and accordingly how to meet them.

- A more detailed standard would be more complex and expensive to implement not even considering about changing it. Accordingly it would not enable innovation in the same way as a more informal one.

The open, simple and informal character of the CPA standard made the standard *flexible*. Flexibility is of utmost importance in an unpredictable and rapidly changing environment like that of mobile services. This flexibility also made the standard *robust*. It is robust in the sense that when new requirements emerge, the overall infrastructure can be accommodated to them in several ways. New functionality can be provided by enhancing the basic platform by the network operators or be added to the 'middleware' provided by the integrators and aggregators or it may be implemented by the content providers. It is thus also robust in the sense that modifications can be done by different actors. This means that the modifications and the work can be done where and by those best suited and most committed. The network operators are hesitant to reveal details about, discuss and indeed coordinate their internal systems such as the billing system. By choosing a standardised service level as well as normalising the standards as far as possible, the network operators (with help from integrators and aggregators) have avoided engaging in such discussions and the potential problems associated with them. But, perhaps most important, this makes the standard robust in the sense that no single actor can block changes being made if this does not fit their (monopoly) interests or if they do not have the resources.

The successful development and diffusion of the CPA standard also depended on the approach followed: It can only be characterised as *bottom-up* and *experimental* or as *evolutionary* and *learning oriented*. This is exactly what is required in an environment like the one of mobile content services. This kind of bottom-up and experimental standardisation also requires specific organisational structures. The organisational structures need to be simple, flexible and dynamic. And the informal and project oriented – or *ad hoc* – organisation of the activities fit those requirements well. This informal approach worked in Norway in particular because the actors on the operational level knew each other fairly well, based on previous collaboration as well as the exchange of personnel among the different organisations.

### 5.4. Is CPA really a standard?

When describing CPA as a standard we have applied a rather broad definition of what a standard is. Others might prefer a more narrow definition viewing a standard as a set of interface specifications agreed upon by members of an SDO. According to such a definition CPA is not a standard. If we adopted such a definition we would tell a different story – a story about how emerging telecommunication markets can develop and where different actors compete and collaborate, where their actions are coordinated, and where interoperability is achieved *without* standards. The interesting element of this story would be the explanation of how that could happen. And the answer is: the emergence of the package we have described here called CPA. The next question would then be: what should this package be called? There are certainly many possibilities. We prefer to call it a standard – just because it plays the roles standards are supposed to play. It is a different standard than those found traditionally – in particular within telecommunications. But we believe the CPA standard and its emergence illustrates a crucial feature of the kinds of standards that are needed in future telecommunication services and how such standards may be developed. Further, CPA fits de Vries' (1999) definition of standardisation as:

*"the activity of establishing and recording a limited set of solutions to actual or potential matching problems directed at benefits for the party or parties involved balancing their needs and intending and expecting that these solutions will be repeatedly or continuously used during a certain period by a substantial number of the parties for whom they are meant"* (p.155)

### 5.5. Open standards

There are several aspects of openness related to the conceptualisation of standards applied here. On the one hand, openness relates to the flexibility provided for change. Being open means allowing for and enabling innovation as well as changing the standard to accommodate new needs as they emerge. While openness is a virtue for those who pursue growth, the specific degree of openness of a standard also relates to political judgment about where and how to limit openness. On the other hand, not only is openness related to accommodation of innovations, but also who are allowed to participate in the creation and maintenance of the standards. When standards are not defined as outputs of SDOs or consortia, coordination and standardisation activities will be played out on a variety of different fields. Flexibility of standardisation may, in the same way as flexibility of standards, also enable and support more peripheral activities of standard making, in the case of CPA by network operators, aggregators and application houses. Bottom-up initiatives like this will however run the risk of being trapped in a blind alley. In particular, the standard may become very fragmented and messy as various actors add new features to it independently. To avoid this problem, there is the need to have a process running in parallel with the experimental development of new services which cleans up the implementation of the services that turn out to be viable.

A related issue is whether CPA can be scaled up to a global standard. While content services like ringtones, logos, wallpapers etc, to a large extent are international, the CPA standard and standardisation process are more context dependent. On the one hand, the CPA standard requires the presence of a range

of actors following the same idea and pursuing a common strategy. In particular, the idea of an 'open garden' approach is still seen as alien, and network operators are usually in fierce competition. On the other, the process in which the CPA standard was developed drew upon personal and informal relationships, a common understanding of the principles of CPA, as well as the possibility for local and situated coordination activities. This approach will be more problematic across national borders when involving additional actors and interests. While we should not discard the possibilities that some contexts are not suited for a standard like CPA, we must also acknowledge that following an approach that is based on peripheral and autonomous activities of will necessarily result in different result across different contexts (Ciborra 2000).

## 6. Conclusion

Based on describing the condition in which the Norwegian CPA standard emerged, this paper has attempted to bring new insights into the requirements for standards and the process in which standards emerge in the area of mobile content services. While we cannot give complete answers to all questions posed, we argue that our case gives solid evidence in support of the assumption that open standards are important in this area in the same way as in other areas of telecommunications. But the study also tells us that in order to be successful, such a standard contains more than specifications of technical interfaces. It is a larger package containing a variety of components like business models, the structure of the business sector, short numbers, rating classes and service levels, etc. In addition, such a standard needs to have certain characteristics: It needs to be based on an *open* or end-to-end like (i.e. extensible, scalable) *architecture; complete* in the sense that it covers all aspects that the actors need agreement about; *simple* so that it easy to understand and to use or implement, such that it is cheap and easy to provide new services based on it, and that it is easy to change when new requirements are uncovered; *informal* in the

sense that almost none of its features are specified formally or in detail; *flexible* and *robust* in the sense that when new requirements emerge, the overall infrastructure can be accommodated to them in several ways.

In a turbulent and unpredictable environment due to emerging technologies and new organisational relationships, the organisation of the standardisation work must fulfil basically the same requirements. It needs to be flexible, lean and simple, i.e. informal and based on *ad hoc* projects rather that formal rules, structures and projects. But such an informal and dynamic structure can only work in an area where the actors know each other well and share most basic ideas, visions and values. We will further argue that the emergence of this kind of standard requires a certain balance and equality among the actors. If a few big actors determine that a specific business sector is strategic, they will most likely dominate and develop proprietary platforms. In Norway, this has (fortunately, we argue) not been the case so far.

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